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The Missouri Species of *Elemus*

Benjamin Franklin Bush 49

Report on the Study and Appraisal of Mussel Resources
in Selected Areas of the Upper Mississippi River,

1920-25 *N. M. Grier, Ph. D.* 89

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MISPRINTS IN "STUDIES IN THE COMPOSITAE"

January, 1926. Vol. X, No. 1.

Page 5, line 8, from below "paleaceus"
lege "paleaceous."

Page 6, line 13, from below "many"
lege "as many."

Page 9, line 15, from below "graduiflorus"
lege "gradiflorus."

Page 12, line 2, from below "broadcast"
lege "broadest."

Page 14, line 1, from above "achnia" lege "achenia."

Page 14, line 27, from below insert after middle, "as
shown in the longitudinal section (Fig. 3)"

Omit from "however" up to "This" of line 31.

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The American Midland Naturalist

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Vol. X

MARCH and MAY, 1926.

Nos. 2 and 3.

THE MISSOURI SPECIES OF ELYMUS.

By BENJAMIN FRANKLIN BUSH.

It has long been apparent to every one attempting to name *Elymus* specimens, and to authors of local floras and lists, that there was something radically wrong with our understanding of the species of this genus.

The cause of this misunderstanding was through a misconception of *E. canadensis*, *E. glaucifolius* and *E. virginicus* by Scribner in Gray's Manual 6th edition, in the first place, mainly, and by Hitchcock in the Robinson and Fernald edition of Gray's Manual, 1908, and lastly by Nash in the second edition of Britton and Brown's Illustrated Flora, 1913. These authors in all their writings invariably refused to recognize *E. glaucifolius*, the most common and the most widely distributed, as well as the most variable species of the genus; and they accepted as species without question, forms that are not even worthy of varietal rank.

No one of these authors ever understood *E. canadensis* or knew what *E. glaucifolius* was, although Hitchcock in the Robinson and Fernald edition of Gray's Manual says that var. *glaucifolius* of *E. canadensis*, "corresponds more nearly with the Linnean type," when in reality the *E. canadensis* of Hitchcock in this work is really *E. glaucifolius* of Muhlenberg.

Dr. Wiegand in his paper,¹ has shown that *E. canadensis* does not extend farther west than central New York, and is comparatively rare throughout its range, and that the great-

¹ K. M. Wiegand, some Species and Varieties of *Elymus* in eastern North America, *Rhodora* 20:1918.

er part of what has been passing for *E. canadensis* is *E. robustus* and an undescribed species, which he describes as *E. riparius*.²

Dr. Wiegand curiously overlooked the fact that the type specimens of *E. glaucifolius* came from Pennsylvania, probably from near Philadelphia, and Philadelphia is a long ways from central New York; and further, he states that he has seen no specimens of *E. canadensis* from Pennsylvania. No doubt Dr. Wiegand was misled by Hitchcock's misidentification of Muhlenberg's specimens of *E. glaucifolius*, but if he had stopped a moment to consider this, he would have seen that Muhlenberg's *E. glaucifolius* could not be the same as Linnaeus' *E. canadensis*, which is a species of New England, and that it was the same or nearly the same as the plant Hitchcock called *E. robustus* in the Robinson and Fernald Manual, and which he there gives as its range Illinois and westward. Dr. Wiegand confused *E. glaucifolius* with *E. robustus* in his paper, for he says there that *E. robustus* ranges from Grafton County, New Hampshire, to Vermont, Massachusetts and Connecticut; also from Illinois and Michigan to Montana, Colorado, Texas and New Mexico.³ This leaves quite a strip of the Eastern States not accounted for. This is readily understood when we take into consideration the fact that Wiegand had in hand the real *E. glaucifolius* of the East, and the robust form of the prairie regions that Scribner and Smith had described as *E. robustus*, the former being the *E. canadensis* of Hitchcock in the Robinson and Fernald Manual, but not the *E. canadensis* of Linnaeus. I have examined some 500 or 600 specimens from the central and eastern States that were labeled *E. canadensis*, and of this large number I found three sheets of the real *E. canadensis*, two sheets were *E. riparius* and the remainder were *E. glaucifolius*, or one or the other of its forms. I have examined and observed in the field thousands of plants growing, and contrary to my expectation, the species and varieties or forms herein considered were remarkably constant, so

² Wiegand, l. c. 84.1918.

³ Wiegand, l. c. 89.1918.

much so that I was never at a loss to place any plant, or clump of plants that I saw in the field.

The species and forms observed and studied in the field the past two summers, did not all flower at the same time, but some flowered early and some flowered later, and a study of these flowering periods might be productive of good results if taken up and followed for several seasons.

The usual number of species of *Elymus* credited to Missouri was about twelve, and this number is certainly too large for this genus.

I have been compelled to reduce the number of species of *Elymus* found in Missouri to six, with six varieties or forms, and it may be that a still greater reduction in the number of the species will be necessary when the forms are better studied.

In the course of this study of the species of *Elymus* of Missouri, I have had the advantage of studying the large amount of material in the Herbarium of the University of Illinois, the private collection of Mr. Charles C. Deam, of Bluffton, Indiana, that of Mr. Kenneth K. Mackenzie of Maplewood, New Jersey, some one hundred or more sheets from the United States National Herbarium, Washington, D. C., the large collection of the Herbarium of the University of Minnesota, and a small collection from Mr. E. J. Palmer of Webb City, Missouri.

For the many courtesies extended me by the loan of this great amount of material for study, I am under obligations to Professor William Trelease, Dr. C. O. Rosendahl of Minneapolis, Minnesota, Mrs. Agnes Chase, of the Department of Agriculture, Washington, D. C., Mr. Kenneth K. Mackenzie, Mr. Charles C. Deam, and Mr. E. J. Palmer, to all of whom, and to my friends and correspondents, I herein desire to acknowledge their assistance and express my thanks for aid received.

Having seen and examined more than one thousand specimens of *Elymus* in the course of my two seasons study, I present for the species found in the State the following:

KEY TO THE MISSOURI SPECIES OF ELYMUS

1. Spikelets appressed to the rachis; spikes narrow, very slender; glumes and lemmas long-armed, smooth; culms slender, moderately tall, smooth; leaves short, narrow, erect.
 1. ELYMUS MACKENZII
1. Spikelets spreading; spikes usually stout, sometimes very broad; glumes and lemmas more or less variable in the same species; leaves long, broad, spreading; culms usually stout, usually tall. 2.
2. Awns straight when mature and dry; palea 6-8 mm. long, or rarely longer in some forms of *E. virginicus*; leaves thin, scarcely striate, 5-12 mm. wide, not or scarcely involute when dry. 3.
2. Awns curved outwards toward the apex when mature and dry; palea 9-11 mm. long; leaves firm, thick, striated, 5-20 mm. wide, strongly involute, at least when dry. 10.
3. Glumes and lemmas broad, the former indurated and more or less curved at the white or yellowish base. 4.
3. Glumes and lemmas narrow, often setiform, the former indurated and terete below, essentially straight. 9.
4. Glumes and lemmas muticous, or with awns very short, seldom more than one-fourth their entire length. 2D. *Elymus virginicus submuticus*.
4. Glumes and lemmas awned, the awns usually one-half their entire length, sometimes longer, rarely shorter. 5.
5. Glumes 10-25 mm. long. 6.
5. Glumes over 25 mm. long; spikes exserted. 8.
6. Glumes and lemmas villous-hirsute. 2A. *Elymus virginicus intermedius*.
6. Glumes and lemmas glabrous, or merely scabrous on the margins. 7.
7. Spikes usually included at the base in the enlarged upper sheath, usually slender and closely flowered. 2. *Elymus virginicus*.
7. Spikes usually long-exserted, thicker, the spikelets more stiff and spreading. 2c. *Elymus virginicus jejunus*.
8. Glumes and lemmas glabrous or merely strigose-scabrous;

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glumes wider, over 1 mm. wide, much curved and indurated at the striated whitish base. 2B. *ELYMUS VIRGINICUS GLABRIFLORUS*.

8. Glumes and lemmas villous-hirsute; Glumes narrow, under 1 mm. in width, somewhat curved at the unstriated yellowish base; upper sheath scarcely enlarged. 3 *ELYMUS AUSTRALIS*.
9. Glumes and lemmas villous-hirsute, the former very narrow, sometimes almost setiform. 4. *ELYMUS STRIATUS*.
9. Glumes and lemmas glabrous, or merely strigose-scabrous, the former wider than those of No. 4. 5. *ELYMUS ARKANSANUS*.
10. Spikes erect, thick; plants flowering earlier than the other two forms. 6B. *ELYMUS GLAUCIFOLIUS ROBUSTUS*.
10. Spikes nodding or drooping. 11.
11. Spikes very thick, nodding; plants flowering very late, later than the other two forms. 6. *ELYMUS GLAUCIFOLIUS*.
11. Spikes long and slender, drooping; plants flowering somewhat earlier than the typical form. 6A. *ELYMUS GLAUCIFOLIUS CRESCENDUS*.

1. *ELYMUS MACKENZII* B. F. Bush, n. sp.

Culms very slender, moderately tall, 9-12 dm. high; sheaths close, not inflated, smooth; leaves light green, 1-2 dm. long, 4-8 mm. wide, smooth beneath, densely pubescent above with long whitish hairs; spikes long-exserted, slender, about 5 mm. thick; spikelets appressed to the rachis, single at each joint of the rachis, or the lower sometimes in pairs, 1-3-flowered; glumes 2, 3 or 4 at each joint of the rachis, awl-shaped; the body of the glume about 9 mm. long, strongly 5-7-nerved, with a slender awn 6-8 mm. long; lemmas lanceolate, smooth, or roughly 5-nerved at the apex, about 9 mm. long, each with a slender awn 20-30 mm. long; paleas thin, 7-9 mm. long.

Plants growing singly or two or three together, never in clumps, on the bare faces of high rocky bluffs along the White River in Barry County, Missouri. No doubt occurring all along the White River bluffs in northwestern Arkansas. Named for Mr. Kenneth K. Mackenzie, who, in company with

the writer, first noted this peculiar species of *Elymus* at the type locality.

Type, *Bush* 77, Eagle Rock, Missouri, June 15, 1897, U. S. N. Herb. No. 318128; cotypes in Herbarium of Missouri Botanical Garden, Sheet No. 119875, and in Herbarium of Kenneth K. Mackenzie.

This has been referred to both *E. Macounii* and *E. glaucus*, but differs conspicuously from both these species, and furthermore, is clearly outside of the known range of these species. The specimens collected in June, 1897, were determined by myself and Mr. Mackenzie as *E. Macounii*, and distributed under that name, which no doubt caused Nash to cite *E. Macounii* for Missouri in the Illustrated Flora, 289, 1913, but the range he there ascribes to *E. Macounii* could not possibly include Missouri. I have examined many specimens of *E. Macounii* from Montana, Western Nebraska, New Mexico, Nevada, Colorado, North Dakota, South Dakota, Oregon, Washington, Wyoming, Idaho and Saskatchewan. The type "Great Plains of British America," is far from extreme southern Missouri, and is about as much like Barry County, Missouri, as the Llano Estacado is like Virginia. The specimens sent to the United States National Herbarium were labeled *E. Macounii*, but the specific name was crossed out, and the name *glaucus* written on the label by Hitchcock, but the range of *E. glaucus* as given by him in the Robinson and Fernald Manual in 1908 does not include Missouri by more than 500 miles. I have had many sheets of specimens of *E. glaucus* to examine, from California, Western Colorado, Washington, Oregon, Montana, North Dakota, Idaho, Nevada, Wyoming and Vancouver. The type locality of *E. glaucus*, "Columbia River" (probably Oregon or Washington), is more than 2000 miles from southern Missouri, and the floras of the two regions are about as unlike, as are the floras of Maine and Texas.

2. *ELYMUS VIRGINICUS* L. Sp. Pl. 84. 1753.

REFERENCES:

ELYMUS VIRGINICUS L. Sp. Pl. 84 (1753); Bush, Flora of Jackson County, Missouri, Suppl. 901 (1885); Tracy, Flora

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of Missouri, 1733 (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey, Coulter, Manual of the Plants of Western Texas 3:550 (1894); Mackenzie and Bush, Manual of the Plants of Jackson County, Missouri, 38 (1902); Nash, Small, Flora, 160 (1913); Nash, Britton and Brown, Illustrated Flora, 1:291 (1913); Palmer, Flora of Jasper County, Missouri, 365 (1916); Wiegand, Rhodora 20:83 (1918).

"*E. sibiricus* L," Bush, Flora of Jackson County, Missouri, 580 (1882). "*E. Sitanion* Schultz," Tracy, Flora of Missouri, 1730 (1886). "*E. glaucus* Buckley," Palmer, Flora of Jasper County, Missouri, 365 (1916). *E. carolinianus* Walter, Flora Carol. 82 (1788). *E. nitidus* Vasey, Bull. Torr. Club 13:120 (1886). *E. virginicus minor* Vasey, Contr. U. S. Nat. Herb. 2:550 (1891).

TYPE LOCALITY: Virginia.

Nova Scotia and New Brunswick to Manitoba, south to Florida and Texas, Nash, l. c. 156, 1905.

Nova Scotia to Florida, and westward, Hitchcock, l. c. 169, 1908.

Nova Scotia to Manitoba, south to Florida and Texas, Nash, l. c. 291, 1913.

Nova Scotia and New Brunswick to Manitoba, Florida and Texas, Nash, l. c. 160, 1913.

Newfoundland and Quebec to District of Columbia, westward to Montana and Colorado, southward to Louisiana and Texas, Wiegand, l. c. 83, 1918.

A very variable species, having the greatest range of forms of any North American species of *Elymus*, as well as having the greatest range, presenting many forms in this State, some of which have been recognized as species by different writers, all of the varieties here presented being generally recognized as species, but I have seen too many intergrading specimens between all of the forms, that I think it would be better to regard them as varieties, if indeed, some of them can lay claims for more than mere forms.

SPECIMENS EXAMINED:

MAINE

Orono, *Knight*, August 10, 1084, M. Herb.*

CONNECTICUT

Southington, *Bissell*, August 3, 1902, D. Herb.

NEW JERSEY

Millburn, *Mackenzie* 314, July 26, 1903, M. Herb.; South River, *Mackenzie* 3766, August 23, 1908, M. Herb.; Wildwood, *Chase* 3510, July 25, 1906, U. of Ill., Herb.; Woodbridge, *Lighthipe*, August 11, 1891, U. of Minn. Herb.

DISTRICT OF COLUMBIA

Anacostia, *Pollard* 425, June 23, 1895, U. of Minn. Herb.; Anacostia, *Pollard* 425, June 23, 1895, U. of Minn. Herb.

VIRGINIA

Cumberland County, *Stevens* 6846, June 14, 1902, U. S. N. Herb. No. 1020416; Four mile Run, *Chase* 2449, July 19, 1904, U. of Ill. Herb.; Jackson City, *Steele*, May 19, 1902, U. S. N. Herb. No. 557848; Potomac River, *Ball* 793, June 28, 1902, U. S. N. Herb. No. 730994; Potomac River, *Ball* 793, June 28, 1902, U. S. N. Herb. No. 1020407.

INDIANA

Angola, *Deam* 52531, August 29, 1920, D. Herb.; Baum Bridge, *Deam* 26473, September 15, D. Herb.; Cannelton, *Deam* 16634, June 19, 1915, D. Herb.; Carmel, *Deam* 9522, August 8, 1911, D. Herb.; Chrisney, *Deam*, 28353, July 18, 1919, D. Herb.; Chrisney, *Deam* 28968, August 13, 1919, D. Herb.; Chrisney, *Deam* 28968, August 13, 1919, D. Herb.; Decker, *Deam* 32853, September 21, 1920, D. Herb.; Deer-

*For convenience I have used the following abbreviations: M. D., and P. refer to the collections of Mackenzie, Deam and Palmer; U. S. N. the United States National Herbarium; U. of Minn., the University of Minnesota; U. of Ill., the University of Illinois; F. M. of N. H., the Field Museum of Natural History; M. B. G., the Missouri Botanical Garden.

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field, *Deam* 15381, September 13, 1914, D. Herb.; Erie County, *Deam*, July 12, 1903; Goldsmith, *Deam* 15348, September 3, 1914, D. Herb.; Hillsdale, *Deam* 9838, August 27, 1911, D. Herb.; Huntingburg, *Deam* 28322, July 18, 1919, D. Herb.; Indianapolis, *Deam* 13544, July 2, 1913, D. Herb.; Kentland, *Deam* 21558, August 30, 1916, D. Herb.; Lafayette, *Deam* 11672, July 20, 1915, D. Herb.; Laketon, *Deam* 22038, September 18, 1916, D. Herb.; Leavenworth, *Deam* 20404, June 22, 1916, D. Herb.; Leesburg, *Deam* 33489, October 1920, D. Herb.; Manville, *Deam* 16210, June 20, 1915, D. Herb.; Mollie, *Deam* 322, August 13, 1905, D. Herb.; Mongo, *Deam* 32476, August 28, 1920, D. Herb.; Monticello, *Deam* 32197, August 22, 1920, D. Herb.; Mount Union, *Deam* 16814, July 3, 1915, D. Herb.; Mount Vernon, *Deam* 33037, September 25, 1920, D. Herb.; Ontario, *Deam* 15046, August 30, 1914, D. Herb.; Perrysville, *Wright*, June, 1893, U. of Minn. Herb.; Petersburg, *Deam* 16961, July 7, 1915, D. Herb.; Pleasant Mills, *Deam* 32573, August 31, 1920, D. Herb.; Prairietown, *Deam* 32903, September 17, 1920, D. Herb.; Remington, *Deam* 11817, July 30, 1912, D. Herb.; Schneider, *Deam* 18143, August 24, 1915, D. Herb.; Shelton, *Deam* 25474, June 18, 1918, D. Herb.; Wells County, *Deam*, August 24, 1902, D. Herb.; Weston, *Deam* 28081, July 14, 1919, D. Herb.; Wilder, *Deam* 32220, August 23, 1920, D. Herb.; Wilder, *Deam* 32221, August 23, 1920, D. Herb.; Yankeetown, *Deam* 16725, July 2, 1915, D. Herb.

ILLINOIS

Akron, *Chase* 68, July 12, 1887, U. of Minn. Herb.; Chicago, *Moffatt*, August 27, 1889, U. of Ill. Herb.; Chicago, *Moffatt* 310, August 27, 1893, U. of Minn. Herb.; Decatur, *Clokey*, August 1, 1898, U. of Ill. Herb.; Du Page County, *Moffatt*, August 13, 1892, U. of Minn. Herb.; Glencoe *Sherff* 1736, August 20, 1912, U. of Ill. Herb.; Mahomet, *Gibbs* and *Clinton*, October 10, 1898, U. of Ill. Herb.; Mount Carmel, *Schneck*, June 1879, U. of Ill. Herb.; Mount Carbel, *Schneck*, July 28, 1900, U. of Ill. Herb.; No locality given, *Schneck*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *McDonald*, August, 1903, U.

of Ill. Herb.; Urbana, *Seymour*, August 3, 1880, U. of Ill. Herb.; Wabash County, *Schneck*, June 30, 1878, U. of Ill. Herb.; Wabash County, *Schneck*, July 17, 1879, U. of Ill. Herb.; Wabash County, *Schneck*, June 29, 1904, U. of Ill. Herb.; Wabash County, *Schneck*, June 27, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1599, August 17, 1907, U. of Ill.; Herb.

MISSOURI

Aberdeen, *Davis*, September 11, 1911, U. of Ill. Herb.; Aberdeen, *Davis* 1143, September 24, 1911, U. S. N. Herb.; No. 673982; Allenton, *Letterman*, July 20, 1883, U. S. N. Herb. No. 986185; Allenton, *Letterman*, August 1, 1883, U. S. N. Herb. No. 986184; Carruthersville, *Hitchcock*, month not given (1904, U. S. N. Herb.; No. 731052; Courtney, *Bush* 795, July 11, 1896, U. S. N. Herb.; No. 282374; Courtney, *Bush* 817, August 1, 1900, U. S. N. Herb. No. 386727; Courtney, *Bush* 1153, September 10, 1901, M. Herb.; Courtney, *Bush* 8392, June 14, 1918, U. of Ill. Herb.; Courtney, *Bush* 8443, June 29, 1918, U. of Ill. Herb.; Courtney, *Bush* 8406, June 17, 1918, U. of Ill. Herb.; Courtney, *Bush* 8471, July 9, 1918, U. of Ill. Herb.; Courtney, *Bush* 9098, August 12, 1920, U. of Ill. Herb.; Courtney, *Bush* 9104, August 12, 1920, U. of Ill. Herb.; Courtney, *Bush* 9134, August 20, 1920, U. of Ill. Herb.; Courtney, *Bush* 9339, October 22, 1920, U. of Ill. Herb.; Creve Coeur Lake, *Sherff* 513, July 17, 1910, U. S. N. Herb.; No. 288679; Creve Coeur Lake, *Sherff* 513, July 17, 1910, U. S. N. Herb. No. 288680; Floyd, *Bush* 9398, July 11, 1921, U. of Ill. Herb.; Hannibal, *Davis*, September 11, 1911, U. of Ill. Herb.; Medill *Bush* 9163, August 24, 1920, U. of Ill. Herb.; Neck City, *Palmer* 18126, July 1, 1920, P. Herb.; Neck City, *Palmer* 18127, July 1, 1920, P. Herb.; Oakwood, *Davis* 1316, October 4, 1911, U. S. N. Herb. No. 674012; Sheffield, *Mackenzie*, July 29, 1901, M. Herb.; Springfield, *Standley* 8359, August 29, 1911, U. S. N. Herb. No. 687319; Springfield, *Standley* 9154, August 21, 1912, U. S. N. Herb. No. 688072; Strafford, *Standley* 9456, August 27, 1912, U. S. N. Herb. No. 688372; Webb City, *Palmer* 15987, July 30, 1918, P. Herb.; West-

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port, *Mackenzie*, June 25, 1896, D. Herb.; Westport, *Mackenzie*, June 25, 1896, M. Herb.; Westport, *Mackenzie*, June 25, 1896, U. of Minn. Herb.

NORTH CAROLINA

Stotesville, *Hyams*, date not given. U. of Minn. Herb.

SOUTH CAROLINA

Simpson's Mill, *Davis* 7906, August 29, 1917, U. of Ill. Herb.

MICHIGAN

Alma, *Davis*, date not given, U. of Ill. Herb.; Jackson County, *Camp*, July 13, 1895, U. of Minn. Herb.; Jackson County, *Camp*, July 13, 1895, U. of Minn. Herb.

IOWA

Fayette, *Fink*, July 29, 1893, U. of Minn. Herb.; Muscatine, *Mackenzie*, September 8, 1894, M. Herb.

MINNESOTA

Hennepin County, *Aiton*, August, 1887, U. of Minn. Herb.; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Heron Lake, *Skinner* 303½, June, 1902, U. of Minn. Herb.; Jefferson, *Wheeler* 418, July 26, 1899, U. of Minn. Herb.; Jordan, *Ballard* 389, July, 1891, U. of Minn. Herb.; Minneapolis, *Oestlund*, July, 1886, U. of Minn. Herb.

KANSAS

Argentine, *Mackenzie*, June 26, 1896, M. Herb.; Argentine, *Mackenzie*, June 28, 1896, M. Herb.; Argentine, *Mackenzie*, June 28, 1896, M. Herb.; Rosedale, *Mackenzie*, July 12, 1896, M. Herb.

NEBRASKA

No locality given, *Hayden*, 1853-1854, U. of Minn. Herb.; Redland, *Bates* 5662, August 4, 1912, U. of Minn. Herb.

SOUTH DAKOTA

Lake Ibsen, *Lunell*, September 4, 1899, M. Herb.; Lake Ibsen, *Lunell*, July 28, 1900, U. of Minn. Herb.; Lake Ibsen.

Lunell, August 15, 1906, D. Herb.; *Lunell*, August 15, 1906, U. of Ill. Herb.; Lake Ibsen, *Lunell*, July 26, 1915, D. Herb.; Lake Ibsen, *Lunell*, 181, July 26, 1915, U. of Ill. Herb.; Turtle Mountains, *Lunell*, July 21, 1905, D. Herb.; Turtle Mountains, *Lunell*, July 21, 1905, M. Herb.

GEORGIA

Banks of the Coosa, *Chapman* 23, month not given, 1883, U. S. N. Herb. No. 1020418; cited by Scribner and Ball as *E. glabriflorus*, but apparently not that variety.

ALABAMA

Montgomery, *Baker*, June 1, 1897, U. of Minn. Herb.

LOUISIANA

Alexandria, *Ball* 402, May 19, 1899, U. of Minn. Herb.

OKLAHOMA

Mountain Park, *Stevens* 1225, June 23, 1813, U. of Minn. Herb.; Stillwater, *Hitchcock* 1615, August 8, 1918, U. S. N. Herb. No. 103219.

TEXAS

Abilene, *Tracy* 8114, May 19, 1902, U. of Minn. Herb.; Dallas, *Reverchon* 1139, June 4, 1900, M. Herb.; Tarrant County, *Ruth* 52, June 10, 1913, U. of Ill. Herb.

NO STATE GIVEN:

Vermilion River, *Browhelm*, October 6, 1921, M. Herb.
2A. *ELYMUS VIRGINICUS INTERMEDIUS* (Vasey) n. comb.

REFERENCES:

ELYMUS VIRGINICUS INTERMEDIUS (Vasey) Bush. *E. canadensis intermedius* Vasey; S. Wats. & Coulter, A. Gray, Man. ed. 6, 673 (1890). *E. intermedius* (Vasey) S. & S. Bull. Div. Agrost. 4: 38 (1891). *E. hirsutiglumis* Scribner, Bull. Div. Agrost. 11: 58 (1898); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Nash. Britton. Manual, 157 (1905); Nash, Britton & Brown, Illustrated Flora, 1: 292 (1913). *E. virginicus hirsutiglumis* (Scribner) Hitchc.; Rhodora 10: 65 (1908); Wiegand, Rhodora 20: 83 (1918).

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TYPE LOCALITY: No locality given.

Maine to Virginia and Nebraska, Nash, l.c. 157, 1905.

Maine to Virginia and Nebraska, Hitchcock l.c. 169, 1908.

Maine to North Carolina, Illinois and Nebraska, Nash, l. c. 160, 1913.

Maine to Virginia, Tennessee, Missouri and Nebraska, l.c. 292, 1913.

Maine to Pennsylvania, Nebraska and Missouri, Wiegand, l.c. 84, 1918.

Extreme forms of this variety look very distinct from *E. virginicus*, but there are so many intermediate specimens that it is best to consider it only a variety of that species. It does not resemble *E. canadensis* (i. e. *glaucifolius*) in the least, as that species has the awns of the glumes and lemmas curved outward toward the apex, and the glumes are flattish and but slightly indurated at the base. The name given to this variety clearly has precedence over Scribner's name, and I can not see why Wiegand accepted Hitchcock's combination, published 18 years later than Vasey's.

SPECIMENS EXAMINED:

MAINE

Cape Elizabeth, *Norton*, September 13, 1919, D. Herb.; Orono, *Knight*, August 7, 1904, M. Herb.

NEW YORK

Elmira, *Lucy*, 11752, July 22, 1895, U. of Minn. Herb.; Elmira, *Lucy* 11752, July 22, 1895, U. of Minn. Herb.; Onondago, *Goodrich*, July 30, 1882, U. of Minn. Herb.

NEW JERSEY

Pequannock, *Mackenzie* 3807, August 30, 1908, D. Herb.

DISTRICT OF COLUMBIA

Little Falls, *Topping*, August 18, 1895, U. of Minn., Herb.; Washington, *Steele*, July 29, 1896, U. of Minn. Herb.

INDIANA

Clark County, *Deam* 26255, August 17, 1918, D. Herb.; Decatur, *Deam* 5362, September 8, 1908, D. Herb.; George-

town, 7625, September 28, 1910, D. Herb.; Rainesville, *Deam* 7625, September 28, 1910, D. Herb.; Rainesville, *Deam* 32734, September 15, 1920, D. Herb.; Warren, *Deam* 32608, August 13, 1920, D. Herb.

ILLINOIS

Carlinville, *Andrews*, July 29, 1889, U. of Ill. Herb.; Mascoutah, *Welsh*, 1862-1871, U. of Ill. Herb.; Mount Carmel, *Schneck*, June, 1888, U. of Ill. Herb.; Taylorville, *Andrews*, July 25, 1898, U. of Ill. Herb.; Taylorville, *Andrews*, August 1, 1898, U. of Ill. Herb.; Wabash County, *Schneck*, September 4, 1904, U. of Ill. Herb.; Wady Petra, *Chase*, July 29, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1541, August 11, 1907, U. of Ill., Herb.

MISSOURI

Courtney, *Bush* 1740, July 11, 1902, U.S.N. Herb. No. 440193, closely approaching the specific form, but more nearly like specimens of the variety from the Eastern States; Courtney, *Bush* 1740, July 11, 1902, M. Herb., verging strongly towards *virginicus*; Courtney, *Bush* 9112, August 14, 1920, U. of Ill. Herb.; Martin City, *Mackenzie* 32, July 25, 1902, M. Herb.; Monteer, *Bush* 1125, October 23, 1901, M. Herb.; Sibley, *Mackenzie* 635, October 14, 1901, M. Herb.; Swope Park, *Bush*, 9448, July 22, 1921, U. of Ill. Herb.; Swope Park, *Mackenzie* 433, September 13, 1908, M. Herb.

MICHIGAN

East Lansing, *Yuncker* 733, August 9, 1917, U. of Ill. Herb.

2. *B. ELYMUS VIRGINICUS GLABRIFLORUS* (Vasey) n. comb.

REFERENCES:

E. VIRGINICUS GLABRIFLORUS (Vasey) *Bush*. *E. canadensis glabriflorus* Vasey; Dewey, Manual of the Flora of Western Texas 3:550 (1914), in great part. *E. glabriflorus* (Vasey) Scribner and Ball, Bull. Dev. Agrost. 24:49 (1901); Nash, Britton Man. 2nd ed. Suppl. 1054, 1905; Nash, Britton & Brown, Ill., Flora, 2nd ed. 1: 291, (1913); Palmer, Flora of

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Jasper County, Missouri, 365 (1916). *E. australis glabriflorus* (Vasey) Wiegand, *Rhodora* 20: 84 (1918).

TYPE LOCALITY: Central Texas to Georgia.

Pennsylvania to Tennessee and Georgia, west to New Mexico, Nash, l.c. 1054, 1905.

Massachusetts and Maryland to Florida, westward through Tennessee and Illinois to Nebraska and Texas, Wiegand, l.c. 83, 1918.

Differs from *E. virginicus* only in the long-awned glumes and lemmas, some plants having these much longer than those of typical specimens of *virginicus*. The glumes and lemmas of this variety may be longer and straighter, narrower, less striated, and less curved than those of typical specimens of *virginicus*, but in such a polymorphous species these differences are not of sufficient importance to be of specific value. The type specimen of *E. virginicus* came from the coast region of Virginia, and is about as unlike the plant of the interior region in appearance, as the most extreme form of *E. virginicus intermedius* is unlike the same form, and yet no one has ever proposed to separate the interior prairie form from the coast plant. The typical form of *E. virginicus* as found along the coast from Massachusetts to Virginia and Florida, is a plant having a very thick, stiff spike, the glumes and lemmas short and broad, and very thick, much curved, closely appressed to the rachis, and bears no resemblance whatever to the plant of the interior prairie region, nor to the variety *glabriflorus*, but an examination of any large collection of specimens of *Elymus* will show all degrees of intermediates between these three.

SPECIMENS EXAMINED: District of Columbia.

Bennings, *Steele*, July 2, 1900, U. S. N. Herb. No. 730988; Hamilton Hill, *Ball* 701, July 30, 1900, U. S. N. Herb. No. 731055; Tenallytown, *Kearney* 15, August 16, 1897, U. S. N. Herb. No. 1020406; Washington, *Steele*, July 31, 1896, U. of Minn. Herb.

VIRGINIA

Munden, *Mackenzie* 1675, September 3-19, 1905, M. Herb.; Norfolk, *Kearney* 293, August 5, 1895, U. S. N. Herb. No. 1020411.

TENNESSEE

Cowan, *Ruth* 23, July, 1898, M. S. N. Herb. No. 1020420.

MISSOURI

Joplin, *Palmer* 19098, September 17, 1920, P. Herb.; Noel, *Palmer* 19049, P. Herb.; Webb City, *Bush* 9076, August 7, 1920, U. of Ill. Herb.; Webb City, *Palmer* 18180, July 2, 1920, P. Herb.

NORTH CAROLINA

Eastern North Carolina, *McCarthy*, July, 1885, U. S. N. Herb. No. 153586; Spray, *De Chalmont*, date not given, U. S. N. Herb. No. 366864; Wilmington, *Chase* 7238, June 5-7, 1916, U. S. N. Herb. No. 1020414.

SOUTH CAROLINA

Florence, *Ball* 586, August, 1900, U. of Minn. Herb.

NEBRASKA

Nemaha, *Bates* 149, July 5, 1910, U. of Minn. Herb.

GEORGIA

Hawkinsville, *Harper* 1384, June 27, 1902, U. S. N. Herb. No. 431687.

ALABAMA

Nesheka, *Carver* 9, July 10, 1897, U. S. N. Herb. No. 1020421.

FLORIDA

Cedar Keys, *Tracy* 7774, June 2, 1901, U. of Minn. Herb.; Santa Rosa Island, *Tracy* 8597, May 29, 1903, U. of Minn. Herb.

LOUISIANA

Arcadia, *Ball* 84, August 11, 1898, U. S. N. Herb. No. 1020427.

ARKANSAS

Benton County, *Plank* 101, date not given, U. S. N. Herb. No. 1020424.

OKLAHOMA

Guthrie, *Stevens* 3269, June 14, 1914, U. of Ill. Herb.; Page, *Stevens* 1467, June 20, 1914, U. of Ill. Herb.

TEXAS

Ennis, *Smith*, July, 1898, U. S. N. Herb. No. 1020455; No locality given, *Thurrow*, date not given, U. S. N. Herb. No. 1020451; San Antonio, *Wilkinson* 76, month not given, 1897, M. Herb.

2c. ELYMUS VIRGINICUS JEJUNUS (Ramaley) Bush.

REFERENCES:

ELYMUS VIRGINICUS JEJUNUS (Ramaley) Bush.

E. virginicus forma *jejuna* Ramaley, Bull. Geol. and Nat. Hist. Surv. Minn. 9: 114 (1894). *E. jejuna* (Ramaley) Rydberg, Bull. Torr. Club 36: 114 (1909).

TYPE LOCALITY: Lake Benton, Minnesota.

Minnesota and North Dakota to Nebraska, Nash, 1 c. 291, 1913. This form was considered a good species by Rydberg and accepted by Nash, almost entirely on the exserted spikes and the narrow, close upper sheaths, which distinguishes it from the ordinary forms of *E. virginicus*, the spikes in that species usually being partly or wholly included in the broad inflated upper sheaths. The spikes of this variety are shorter, thicker, stiffer, and the spikelets more spreading, the glumes and lemmas longer awned, and the whole plant is more strict than is *E. virginicus*. There are, however, many plants that are intermediate between this variety and *E. virginicus*, and in my opinion it is better to consider it only a variety of that species.

SPECIMENS EXAMINED:

INDIANA

Pine, *Umbach*, June 29, 1898, D. Herb.

ILLINOIS

Laura, *Chase* 1825, July 5, 1908, U. of Ill. Herb.

MISSOURI

Carl Junction, *Palmer* 3024, July 22, 1910, U. S. N. Herb. No. 671763; Courtney, *Bush* 790, June 28, 1896, M. Herb.; Courtney, *Bush* 8443, June 29, 1918, U. of Ill. Herb.; Courtney, *Bush* 8518, July 16, 1918, U. of Ill. Herb.; Courtney, *Bush* 913, August 12, 1920, U. of Ill. Herb.; Courtney, *Bush* 9379, July 4, 1921, U. of Ill. Herb.; Lee Summit, *Mackenzie*, July 6, 1900, M. Herb.; Oronogo, *Palmer* 18774, August 22 1920, P. Herb.; Sheffield, *Mackenzie* 247, July 17, 1898, F. M. of N. M. Herb.; Sheffield, *Mackenzie* 247, July 17, 1898, M. Herb.; Webb City, *Bush* 9072, August 7, 1920, U. of Ill. Herb.; Webb City, *Bush* 9075, August 7, 1920, U. of Ill. Herb.

MINNESOTA

Lake Benton, *Sheldon* 1375, August, 1891, type of *Elymus virginicus* forma *jejuna* Ramaley, U. of Minn. Herb.; Saint Louis River, *Arthur, Bailey and Holway* 265, July 23, 1886, U. of Minn. Herb.

KANSAS

Quindaro, *Mackenzie*, June 21, 1896, M. Herb.

NEBRASKA

Beatrice, *Bates*, July 9, 1900, U. of Minn. Herb.; Valentine, *Bates*, August 16, 1912, U. of Minn. Herb.

NORTH DAKOTA

Lake Ibsen, *Lunell*, August 15, 1906, M. Herb.

OKLAHOMA

Caddo, *Stevens* 949, June 15, 1913, U. of Minn. Herb.; Ingersoll, *Stevens* 1778, August 1, 1913, U. of Minn. Herb.; Lamont, *Stevens* 1805, August 2, 1913, U. of Minn. Herb.

TEXAS

No locality given, *Nealley*, no month given, 1896, U. of Minn. Herb.

2D. *ELYMUS VIRGINICUS SUBMUTICUS* Hook. Fl. Bor. Am. 2: 255, 1840.

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REFERENCES:

ELYMUS VIRGINICUS SUBMUTICUS Hook. Fl. Bor. Am. 2:255, (1840); Hitchcock. A. Gray, Manual, 169 (1908); Wiegand, Rhodora 20: 84 (1918). *E. curvatus* Piper, Bull. Torr. Club 30: 233 (1903).

TYPE LOCALITY: North America.

Ohio to Minnesota, Kansas and westward, Hitchcock, 1 c. 169, 1908.

Saskatchewan to Iowa, Missouri and Kansas, Nash, 1 c. 290, 1913.

Quebec and the coast of Massachusetts, to Illinois, Saskatchewan, Oklahoma and Washington, Wiegand, 1 c. 84, 1918.

Some specimens of this variety differ very much in aspect from *E. virginicus*, the only species in this region with which it could have any affinity, but there occur so many specimens with spikes that have now and then one or two, and sometimes several spikelets with long-awned glumes and lemmas. The presence of these long-awned glumes and lemmas in the spikes has convinced me that Hooker was right in making this a variety of *E. virginicus*, and I am not sure that it deserves even this rank.

SPECIMENS EXAMINED:

QUEBEC

Dartmouth River, Collins, Fernald and Pease, August 26 and 27, 1904, U. of Minn. Herb.

CANADA

Ottawa, Rolland 6091, August 30, 1917, D. Herb.

ILLINOIS

Mascoutah, Welsh, 1862-1871, U. of Ill. Herb.; Shepherd, Davis 3921, July 23, 1913, U. of Ill. Herb.; Shepherd, Davis, August 24, 1916, U. of Ill. Herb.

MISSOURI

Allentown, Letterman, July 20, 1882, U. S. N. Herb. No. 986185; Courtney, Bush 13, August 7, 1892, U. S. N. Herb.

No. 1020487; this specimen was sent to Vasey for determination under the number 13, and as from Courtney, Missouri, but the specimens were part of No. 802, collected near Sheffield, Missouri. Dr. Vasey reported this to me as a *Hordeum*, species not determined, and as it was collected in the railroad yards near Sheffield, Missouri, where there was no native species, this plant was undoubtedly introduced, probably from Europe; the glumes and lemmas of the spikes of this specimen are very hirsute, and it is very doubtful if this is an *Elymus* species, although it is labeled *E. virginicus submuticus* by Hitchcock; Courtney, *Bush* 761, July 2, 1896, U. S. N. Herb. No. 282381, strongly approaching *E. virginicus*; Courtney, *Bush* 7763, July 28, 1916, M. Herb.; Courtney *Bush* 8617, July 16, 1918, M. Herb.; Courtney, *Bush* 9380, July 4, 1921, U. of Ill. Herb.; Eton, *Bush* 7750, July 24, 1916, M. Herb.; Sheffield, *Bush* 802, August 7, 1892, U. S. N. Herb. No. 208086; this is the same collection as No. 13 sent to Vasey, and erroneously labeled Courtney, Missouri.

MINNESOTA

Crookston, *Skinner* and *MacMillan* 235, August, 1900, U. of Minn. Herb.; Fergus Falls, *Sheldon* 3690, August, 1892, U. of Minn. Herb.; Red Wing, *Sandberg*, August, 1885, U. of Minn. Herb.; Saint Vincent, *Ballard* 2629, August, 1900, U. of Minn. Herb.

KANSAS

Lawrence, *Sterens* 50, August, 1891, U. of Ill. Herb.; Lawrence, *Stevens* 50, August, 1891, U. of Minn. Herb.

NEBRASKA

Grand Falls, *Bates*, September 16, 1912, U. of Minn. Herb.; Nemaha, *W. H.*, August 9, 1910, U. of Minn. Herb.

NORTH DAKOTA

Minot, *Lunell*, September 11, 1902, D. Herb.; Minot, *Lunell*, September 11, 1902, U. of Ill. Herb.; Minot, *Lunell* 182, August 20, 1905, D. Herb.; Minot, *Lunell* 182, August 20, 1905, M. Herb.; Minot, *Lunell* 182, August 20, 1905, U. of Ill. Herb.

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3. *ELYMUS AUSTRALIS* Scrib. & Ball, Bull. Div. Agrost, 24: 46, 1901.

TYPE LOCALITY: Biltmore, North Carolina.

North Carolina to Florida, west to Arkansas and Missouri, Nash, 1. c. 292, 1913.

Connecticut to Missouri and southward, Hitchcock, 1. c. 169, 1908.

Connecticut to Missouri, south to Florida and Arkansas, Nash, 1. c. 292, 1913.

Massachusetts to Georgia, Missouri and Nebraska, Wiegand, 1. c. 84, 1919.

There seems to be some obscurity about this species that I have been unable to clear up. The type-specimens are *Biltmore Herbarium* 511b, Biltmore, North Carolina, July 7, 1897. I have seen and examined a sheet and number of this collection in the Mackenzie Herbarium which I take to be a co-type or duplicate of the type. On this sheet is a fine plant that does not at all agree with the description of *Elymus australis*, nor does it agree with specimens collected in Missouri and referred to *E. australis*. The narrow straight glumes of this Mackenzie specimen, striated at the base, seem to suggest *E. glaucifolius*, while the wide dark green hairy leaves and softly long-hairy culms seem to point to *E. striatus* and it is my opinion that this specimen of the Mackenzie Herbarium is *E. glaucifolius striatus*. The habitat "swampy woods and stream-banks," given as the habitat of *E. australis* by Wiegand^o, does not agree with the habitat of the species of Missouri, which is rocky hills and banks and dry rocky places on prairies.

SPECIMENS EXAMINED:

INDIANA

Aurora, Deam 16040, June 17, 1915, D. Herb.; Romona, Deam 8933, June 25, 1911, D. Herb.

^o Wiegand, 1. c. 84. 1918.

MISSOURI

Alba, *Palmer* 18790, August 23, 1920, P. Herb.; Branson, *Palmer* 19262, September 20, 1920, P. Herb.; Columbia, *Hitchcock*, month not given, 1903, U. S. N. Herb. No. 731061; Eagle Rock, *Bush* 3149, August 7, 1905, M. Herb.; Graydon Springs, *Standley* 9889, September 7, 1912, U. S. N. Herb. No. 688788; Grenwood, *Bush* 9815, June 23, 1922, U. of Ill. Herb.; Joplin, *Palmer* 18429, July 19, 1920, P. Herb.; Joplin, *Palmer* 19740, August 17, 1920, R. Herb.; Neck City, *Palmer* 15666, July 19, 1919, P. Herb.; Oronogo, *Palmer* 18775, August 22, 1920, P. Herb.; Oronogo, *Palmer* 18862, August 29, 1920, P. Herb.; Saint Louis, *Eggert* 193, July 14, 1879, U. S. N. Herb. No. 1020532; Swope Park, *Bush* 9463, July 22, 1921; Webb City, *Palmer* 18767, August 22, 1920, P. Herb.; Webb City, *Palmer* 19020, September 8, 1920, P. Herb.*

GEORGIA

Lula Falls, *Ruth* 16, July, 1898, U. S. N., Herb.; No. 1020525; Thompson's Mills, *Allard*, June 10, 1908, U. S. N. Herb. No. 1020522.

ARKANSAS

Batesville, *Coville*, August 2, 1887, U. S. N. Herb. No. 1020537; Benton County, *Plank* 71, date not given, U. S. N. Herb. No. 1020528; Fayetteville, *Hitchcock* 16092, August 2, 1918, U. S. N. No. 1020528; Fayetteville, *Hitchcock* 16092, August 3, 1918, U. S. N. Herb. No. 1037505.

*Some specimens collected by Davis in northern Missouri were named *E. riparius* by Hitchcock, but evidently erroneously, as no other collection of this species has been seen by me from anywhere near Missouri.

I cite the following specimens which I take to be real *riparius*:

WEST VIRGINIA: White Sulphur Springs, *Mackenzie* 450, September 4, 1903, M. Herb.; White Sulphur Springs, *Mackenzie* 450, September 4, 1903, D. Herb.

NEW YORK: Pitcairn, *Phelps* 132, August 1, 1914, U. S. N. Herb. No. 907724.

CONNECTICUT: Southington, *Bissell*, August 13, 1902, D. Herb.

OKLAHOMA

Ottawa, *Stevens* 2507, August 29, 1913, U. of Minn. Herb.

4. ELYMUS STRIATUS Willd. Sp. Bl. 1: 470. 1797.

REFERENCES:

ELYMUS STRIATUS Willd. Sp. Pl. 1.470, 1797; Bush, Flora of Jackson County, Missouri, 581 (1882); Tracy, Flora of Missouri, 1731 (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey; Coulter, Manual of the Plants of Western Texas 3: 550 (1894); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Daniels, Flora of Columbia, Missouri, 140 (1907); A. Gray Man. ed 7, 169 (1908); Nash; Britton, Man. 156 (1905); Nash Small, Flora S.E.U.S. 160 (1913) Nash; Britton & Brown, Ill. Flora 1: 293 (1913); Wiegand, Rhodora 20: 86 (1918). *E. striatus villosus* A. Gray, Man. ed 5, 639 (1867); Bush, Flora of Jackson County, Missouri, 582 (112); Dewey; Coulter, Manual of the plants of Western Texas 3: 550 (1894) Tracy, Flora of Missouri 1732, (1886); Daniels, Flora of Columbia, Missouri, 141 (1907). *E. striatus Ballii* Pammell, Ia. Geol. Surv. Suppl. Ref. 1903: 347 (1904).

TYPE LOCALITY: America Boreali.

Maine and Ontario to Tennessee, Nebraska and Kansas, Nash, 1. c. 156. 1905.

Maine to South Dakota, southward to New Jersey and Arkansas, Hitchcock, 1. c. 179. 1908.

Main to North Dakota, North Carolina and Texas, Nash, 1. c. 193. 1913.

Maine and Ontario to Tennessee, Nebraska and Kansas, Nash, 1. c. 160. 1913.

Vermont, Massachusetts, Delaware, North Carolina, westward to Wisconsin, Kansas and Oklahoma, Wiegand, L. c. 87. 1918.

A very common species in Missouri, being found throughout the State in all kinds of ground, and presenting a very wide range of forms, but is easily distinguished from all the other species by the very narrow, subulate, aristate glumes.

SPECIMENS EXAMINED:

NEW JERSEY

Holly Beach, *Chase* 3497, July 25, 1906, U. of Ill. Herb.

PENNSYLVANIA

Bucks County, *Ruth*, July 15, 1887, U. of Minn. Herb.

DISTRICT OF COLUMBIA

High Island, *Holm*, August 5, 1913, U. of Ill. Herb.;
Washington, *Steele*, July 4, 1896, U. of Minn. Herb.

OHIO

Cincinnati, *Lloyd*, July 30, 1886, U. of Minn. Herb.

INDIANA

Anderson, *Deam* 2461, August 11, 1907, D. Herb.; Battle Ground, *Deam* 17727, July 20, 1915, D. Herb.; Blackford County, *Deam*, June 25, 1905, D. Herb.; Bluffton, *Deam*, July 26, 1998, M. Herb.; Cannelton, *Deam* 28532, July 23, 1919, D. Herb.; Decker, *Deam* 17023, July 8, 1915, D. Herb.; Franklin, *Deam* 7025, July 9, 1910, D. Herb.; Franklin County, *Deam*, August 23, 1903, D. Herb.; Great Falls, *Chase* 3785 1-2, July 13, 1907, U. of Ill. Herb.; Hebron, *Deam* 32223, August 23, 1920, D. Herb.; Kosciusko, *Deam*, July 12, 1898, D. Herb.; Lowell, *Deam* 3162, July 1920, D. Herb.; Lyons, *Deam* 25654, July 3, 1918, D. Herb.; Manville, *Deam* 16209, June 20, 1915, D. Herb.; Milltown, *Deam* 16410, June 25, 1995, D. Herb.; Mitchell, *Deam* 17235, July 12, 1915, D. Herb.; Mooresville, *Deam* 13661, D. Herb.; New Amsterdam, *Deam* 20495, June 25, 1916, D. Herb.; Patoka, *Deam* 16882, July 6, 1915, D. Herb.; Poseyville, *Deam* 16851, July 5, 1915, D. Herb.; Princeton, *Deam* 25540, June 30, 1918, D. Herb.; Red Key, *Deam* 15432, September 13, 1924, D. Herb.; Turkey Run Park, *Deam* 32851, September 17, 1920, D. Herb.; Vevay, *Deam* 13833, July 25, 1913, D. Herb.; Wabash County, *Deam* 2236, July 7, 1906, D. Herb.; Washington, *Deam* 25616, July 2, 1918, D. Herb.; Wells County, *Deam*, August 3, 1902, D. Herb.; Wells County, *Deam*, August 3, 1912, M. Herb.; Williamsport, *Deam* 11900, August 1, 1912, D. Herb.; Yankeetown, *Deam* 25317, June 11, 1918, D. Herb.

ILLINOIS

Algonquin, *Nason*, July 10, U. of Ill. Herb.; Mahomet, *Seymour*, July 31, 1884, U. of Ill. Herb.; Mascoutah, *Welsch*, 1862-1871, U. of Ill. Herb.; Mount Carmel, *Schneck*, June, 1862-'71, U. of Ill. Herb.; Mount Carmel, *Schneck*, June, 1877, U. of Ill. Herb.; Mount Carmel, *Schneck*, July 1, 1879, U. of Ill. Herb.; No locality given, *Vasey*, date not given, U. of Ill. Herb.; No locality given, *Schneck*, date not given, U. of Ill. Herb.; No locality given, *Welsch*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *McDonald*, August, 1890, U. of Ill. Herb.; Peoria *McDonald*, August, 1900, U. of Ill. Herb.; Peoria, *McDonald* 50 1-2, July, 1904, U. of Ill. Herb.; Peoria, *McDonald* Taylorville, Andrews, July 5, 1898, U. of Ill. Herb.; Taylorville, *Andrews*, June 29, 1899, U. of Ill. Herb.; Urbana, *Gibbs*, October 6, 1898, U. of Ill. Herb.; Wady Petra, *Chase* 128, July 22, 1899, U. of Ill. Herb.; Wady Petra, *Chase* 1236, U. of Ill. Herb.; Wady Petra, *Chase* 1507, July 14, 1907, U. of Ill. Herb.; Wabash County, *Schneck*, June 13, 1879, U. of Ill. Herb.; Wabash County, *Schneck*, June, 1900, U. of Ill. Herb.; Wabash County, *Schneck*, June 19, 1900, U. of Ill. Herb.; Wabash County, *Schneck*, July, 1900, U. of Ill. Herb.; Wabash County, *Schneck*, July 27, 1900, U. of Ill. Herb.; Wabash County, *Schneck*, June 29, 1904, U. of Ill. Herb.; Wheatland, *Umbach*, July 19, 1897.

MISSOURI

Allenton, *Letterman*, July 1, 1894, F. M. of N. M. Herb.; No. 461502; Allenton, *Letterman*, July 1, 1894, U.S.N. Herb. No. 986182; Atherton *Bush* 1760, August 1, 1902, U.S.N. Herb. No. 440205; Atherton, *Mackenzie* 83, August 1, 1902, Atherton, *Mackenzie* 83, August 1, 1902, M. Herb. Columbia, *Hitchcock*, month not given, 1902, U.S.N. Herb. No. 731036; Columbia, *Hitchcock*, date not given, U.S.N. Herb. No. 731265; Courtney, *Bush* 55, June 25, 1892, U.S.N. Herb. No. 1019731; Courtney *Bush* 801, July 11, 1896, U. of Ill. Herb.; Courtney, *Bush* 801, July 11, 1896, U.S.N. Herb. No. 2832775; Courtney, *Bush* 9374, June 29, 1921, U. of Ill.

Herb.; Creve Coeur Lake, *Hitchcock*, month not given, 1894, U.S.N. Herb. No. 731264; Floyd *Bush* 9402, July 11, 1921, U. of Ill. Herb.; Martin City, *Mackenzie* 49, July 25, 1902, D. Herb.; Martin City, *Mackenzie* 49, July 25, 1902, M. Herb.; Neck City, *Palmer* 18128, July 1, 1920, P. Herb.; Oakwood, *Davis* 1216, April 4, 1911, U.S.N. Herb. No. 674012; Saint Louis, *Eggert*, July 7, 1875, U.S.N. Herb. No. 1019732; Waldo Park, *Mackenzie*, July 26, 1896, F.M. of N.M. Herb. No. 431339; Watson, *Palmer* 18942, September 3, 1920, P. Herb.

NORTH CAROLINA

Biltmore, *Biltmore Herbarium* 410-b, July 2, 1897, U. of Minn. Herb.

MICHIGAN

Grand Ledge, collector not given, July 26, U. of Minn. Herb.; Grand Rapids, *Fallas*, July 8, 1897, U. of Minn. Herb.

IOWA

Adair County, *Stewart*, July 2, 1892, U. of Minn. Herb.; Ames, *Stewart*, July 15, 1892, U. of Minn. Herb.; Battle Creek, *Preston* 95%, July 16, 1897, M. Herb.; Muscatine, *Mackenzie* 779, month not given, 1894, M. Herb.

MINNESOTA

Grand Lake, *Campbell* 129, July, 1896, U. of Minn. Herb.; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Luverne, *Wheeler* 1067, September 10, 1901, U. of Minn. Herb.; Swan Lake, *Ballard*, 1005, July, 1862, U. of Minn. Herb.; Swan Lake, *Ballard*, 1005, July, 1892, U. of Minn. Herb.

KANSAS

Quindaro, *Mackenzie*, June 21, 1896, M. Herb.; Quidaro, *Mackenzie*, June 21, 1896, U. of Minn. Herb.

NEBRASKA

Thomas County, *Tulen*, May 5, 1893, U. of Minn. Herb.

SOUTH DAKOTA

Deadwood, *Williams*, July 1, 1892, U. of Minn. Herb.

NORTH DAKOTA

Devil's Lake, *Lunell*, August 10, 1910, D. Herb.; Devil's Lake. *Lunell* 857, August 19, 1910, U. of Ill. Herb.

OKLAHOMA

Tonkawa, *Stevens* 1896 1-2, U. of Minn., Herb.; Tonkawa, *Stevens* 1895 1-2, U. of Minn. Herb.

TEXAS

San Antonio, *Wilkinson* 75, month not given, 1897, M. Herb.

5. ELYMUS ARKANSANUS Scribn. & Ball, Bull. Div. Agrost. 24: 45. 1901.

REFERENCES:

ELYMUS ARKANSANUS Scribn. & Ball, Bull. Div. Agrost. 24: 45. 1901; Nash, Britton, Manual, 1053 (90); Nash, Britton & Brown, Ill. Flora 1: 294 (1913). *E. striatus arkansanus* (Scribn. & Ball) Hitchc. Rhodora 8: 212. (1900); Hitchcock, A. Gray, Manual, 16, (1908); Wiegand, Rhodora 20: 87 (1918).

TYPE LOCALITY: Woods of northwestern Arkansas. Iowa to Arkansas and Missouri, Nash, l. c. 1053. 1905.

Maryland, Iowa and southward, Hitchcock, l. c. 169. 1908.

New Jersey and Staten Island to Iowa, and Arkansas, Nash, l. c. 294. 1913.

Iowa, Missouri, Arkansas, Nebraska, Virginia and Illinois, Wiegand, l. c. 87. 1918.

Generally confused with *E. striatus* by collectors, but seems to have longer and wider glumes and lemmas, which are usually quite glabrous, rarely a little scabrous. I am retaining this plant as a species mainly because it appears to occupy a distinct area of its own.

SPECIMENS EXAMINED:

NEW JERSEY

Millburn. *Mackenzie* 584, September 20, 1903, D. Herb.

VIRGINIA

Bedford County, *Curtis*, July, 1871, U. of Ill. Herb.

INDIANA

Kosciusko County, *Deam*, July 12, 1898, D. Herb.

ILLINOIS

Peoria, *Brendel*, date not given, U. of Ill. Herb.; Stark County, *Chase*, date not given, U. of Ill., Herb.; Wady Petra, *Chase*, June 25, 1897, U. of Ill. Herb.

MISSOURI

Forest Mill, *Palmer* 18365, July 15, 1920, P. Herb.; Medill, *Bush* 9175, August 24, 1920, U. of Ill. Herb.; Noel. *Palmer* 1905, September 10, 1920, P. Herb.; Springfield, *Hoover*, month not given, 1897, U. of Ill. Herb.; Springfield, *Hoover*, month not given, 1897, U.S.N. Herb. No. 1019445 Springfield, *Standley* 8537, August 31, 1911, U.S.N. Herb. No. 687488.

MINNESOTA

Sleepy Eye, *Sheldon* 842, July, 1891, U. of Minn. Herb.; Sleepy Eye, *Sheldon* 976 1-2, July, 1891, U. of Minn. Herb.

SOUTH DAKOTA

Elk Point, *Wallace*, August, 1892, U. of Minn. Herb.

NORTH DAKOTA

Lake Ibsen, *Lunell*, July 26, 1915, D. Herb.; Lake Ibsen, *Lunell*, July 26, 1915, U. of Ill. Herb.

TEXAS

San Antonio, *Heller* 1712, May 5, 1894, U. of Ill. Herb.; San Antonia, *Heller* 1712, U. of Minn. Herb.; Southern Texas, *Lindheimer*, 1849-51, M. Herb.
San Antonio, *Heller*, 1712, U. of Minn. Herb.; Southern 131. 1809.

6. ELYMUS GLAUCIFOLIUS Muhl. in Willd. Enum. Hort Berol. 131, 1809.

REFERENCES:

ELYMUS GLAUCIFOLIUS Muhl. in Willd. Enum. Hort. Berol. 131 (1809); Daniels, Flora of Columbia, Missouri, 100 (1907).

E. canadensis glaucifolius (Muhl.) Torr. Fl. U.S. 1: 137 (1824); Bush, Flora of Jackson County, Missouri, Suppl. 502 (1885); Tracy, Flora of Missouri, 1729, (1886) Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Hitchcock, A. Gray, Man. 169 (1908). *E. canadensis* L., Bush., Flora of Jackson County, Missouri, 579, (1882); Tracy, Flora of Missouri, 1728, (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey; Coulter, Manual of Plants of Western Texas 3: 550 (1894); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Nash, Britton, Manual 157 (1905), in large part; Daniels, Flora of Columbia, Missouri, 100 (1907), in large part; Hitchcock, A. Gray, Manual, 169 (1908), in large part; Nash, Britton & Brown, Ill. Flora, ed 2. 1: 293 (1913); Nash, Small, Flora of the S.E.U.S. ed 2. 160 (1913), in large part; Palmer, Flora of Jasper County, Missouri, 365 (1916) in part. "*E. robustus* S. & S." Wiegand, Rhodora 20: 89 (1918) in large part.

TYPE LOCALITY: Pennsylvania.

There is no doubt in my mind that Muhlenberg's species is distinct from the *E. canadensis* of Linnaeus, and Wiegand has shown this to be so in his paper where he says "although it (*E. glaucifolius*) came from Pennsylvania from which State we have seen no specimens of *E. canadensis*." If Wiegand had only stopped to consider a moment, he would have seen that Muhlenberg's species could not be *E. canadensis* L., for the very reason that the range of that species does not extend to Philadelphia, the place where Muhlenberg collected his species. *E. glaucifolius* came from Pennsylvania, probably from near Philadelphia or Germantown, and Wiegand says it is *E. canadensis*, and then says *E. canadensis* does not occur in Pennsylvania, which seems rather paradoxical to me.

Wiegand further erred in referring the remainder of the eastern plants that had formerly been referred to *E. canadensis*, to *E. robustus*, a species of the interior prairie region,

¹ Wiegand, l. c. 89. 1918.

not realizing that he had in hand two forms of one species.

In a species that is immensely variable, and so very widely distributed, it is only natural that there should be many forms, and that these forms would be taken by some writers for species, and by other writers as varieties. The two varieties that I have here recognized, of this species, I do not feel sure are more than mere forms, but I am sure they are the same forms that have been described by the writers whom I quote as authors of the names here used.

SPECIMENS EXAMINED:

NEW YORK

Ithaca, *Pearce*, October 6, 1883, U.S.N. Herb. No. 153581.

CANADA

Lethbridge, *Hitchcock* 4963, September 19-22, 1909, U. of Ill. Herb.; Lipton, *Clokey* 1630, August 20, 1911, M. Herb.; Ottawa, *Rolland* 35, August 14, 1915, U. of Ill. Herb.; Wies' Beach, *Morris* 178, August 14, 1902, U. of Ill. Herb.

NEW JERSEY

Highland Park, *Mackenzie* 2874, August 25, 1904, M. Herb.; Mount Arlington, *Mackenzie* 910, August 21, 1904, M. Herb.; Phillipsburg, *Mackenzie* 4288, August 15, 1909, M. Herb.

MARYLAND

Beltsville, *Chase* 3834, September 1, 1907, U. of Ill. Herb.; Garrett County, *Smith*, August, 1879, U.S.N. Herb. No. 821762.

DISTRICT OF COLUMBIA

Bennings, *Steele*, June 24, 1902, U. of Ill. Herb.

VIRGINIA

Portsmouth, *Noyes* 37, month not given, 1895, U.S.N. Herb. No. 1020409. This specimen is cited by Scribner and Ball as *E. glab'fleurus* in their paper,⁸ but the specimen apparently belongs to the *virginicus* group. Perhaps Scribner

⁸ Scribner and Ball, 1. c. 49. 1911.

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and Ball were misled by some of Vasey's specimens of *E. robustus*, which he included in his description of *E. canadensis glabriflorus*.

INDIANA

Blue Bluffs, *Deam* 2532, August 18, 1907, D. Herb.; Blue Bluffs, *Deam* 2532, August 18, 1907, D. Herb.; Blue Bluffs, *Deam* 2693, September 22, 1907, D. Herb.; Cedar Lake *Deam* 14618, August 24, 1914, D. Herb.; Cedar Point, *Deam*, July 12, 1903, D. Herb.; Chesterton, *Deam* 18049, August 22, 1915, Herb.; Cicott, *Deam* 32160, August 21, 1920, D. Herb.; Culver, *Deam* 2102L, August 21, 1916, D. Herb.; Culver *Deam* 21020 August 21, 1916, D. Herb.; Delphi, *Deam* 17789, July 22, 1915, D. Herb.; Fowler, *Deam* 11833, July 31, 1912, D. Herb.; Fowler, *Deam* 32726, September 15, 1920, D. Herb.; Franklin County, *Deam*, August 23, 1903, D. Herb.; Goldsmith, *Deam* 13900, August 2, 1913, D. Herb.; Goldsmith, *Deam* 13900, August 2, 1913, D. Herb.; Indiana Harbor, *Deam* 2408, July 28, 1907, D. Herb.; Hillsdale, *Deam* 9798, September 27, 1911, D. Herb.; Hog Back Lake, *Deam* 1261, July 23, 1906, D. Herb.; Moy Back Lake, *Deam* 32522, August 29, 1920, D. Herb.; Indianapolis, *Deam* 14092, August 24, 1913, D. Herb.; James Lake, *Deam* 15502, September 20, 1903, D. Herb.; Lake Cicott, *Deam* 32619, September 14, 1920, D. Herb.; Michigan City, *Deam* 5222, August 16 1908, D. Herb.; Monroe County, *Deam* 12356, September 8, 1912, D. Herb.; Pretty Lake, *Deam* 14886, August 27, 1914, D. Herb.; Rainesville, *Deam* 21588, August 31, 1916, D. Herb.; Remington, *Deam* 11799, July 30, 1912, D. Herb.; Roby, *Sherff* 1694, August 17, 1912, U. of Ill. Herb.; Russellville, *Deam* 7407, August 28, 1910, D. Herb.; Sullivan County, *Deam* 29319, August 21, 1919, D. Herb.; Thayer, *Deam* 21488, August 30, 1916, D. Herb.; Turkey Run, *Deam* 9891, September 2, 1911, D. Herb.; Wells County, *Deam*, September 1, 1904, D. Herb.; Wells County, *Deam*, September, 1904, D. Herb.; Whitley County, *Deam* 14618, August 24, 1914, D. Herb.

ILLINOIS

Canton, Collector and date not given, U. of Ill, Herb.;

Champaign, *Waite*, July 12, 1886, U. of Ill. Herb.; Chicago, *Lansing* 370, July 21, 1898, U. of Minn. Herb.; Ferris, *Gates* 10793, September 1, 1917, U. of Ill. Herb.; Joe Davies County, *Pepoon* 190, August 15, 1908, U. of Ill. Herb.; Mascoutah, *Welsch*, 1862-1871, U. of Ill. Herb.; no locality given, *Chase* 81, August 10, 1897, U. of Ill. Herb.; no locality given, *Chase*, date not given, U. of Ill. Herb.; no locality given, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *McDonald*, July, 1896, U. of Ill. Herb.; Taylorville, *Andrews*, July 27, 1898, U. of Ill. Herb.; Taylorville, *Andrews*, June 21, 1899, U. of Ill. Herb.; Wabash County, *Schneck*, July 26, 1904, U. of Ill. Herb.; Wady Petra, *Chase* 1235, August 7, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1238, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1239 1-2, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1241, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1243, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1244, August 19, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1550, August 17, 1907, U. of Ill. Herb.; Warren, *Pepoon* 74, August 1, 1908, U. of Ill. Herb.; Waukegan, *Gates* 2879, month not given, 1908, U. of Ill. Herb.; Waukegan, *Gates* 2880, month not given, 1907, U. of Ill. Herb.; Waukegan, *Gleason and Shobe* 327, August 16, 1906, U. of Ill. Herb.

MISSOURI

Allenton, *Letterman*, date not given, U.S.N. Herb. No. 986183; Allenton, *Letterman*, June, 1880, U.S.N., Herb. No. 986181; Allenton, *Letterman*, July 25, 1884, U.S.N. Herb. No. 986180; Cartersville, *Palmer* 18243A, July 2, 1919, P. Herb.; Clarksville, *Davis* 1133A, September 24, 1911, U.S.N. Herb. No. 673409; Courtney, *Bush* 780, July 9, 1895, U.S.N. Herb. No. 673988; Courtney, *Bush* 708, July 9, 1896, U. of Ill. Herb.; Courtney, *Bush* 766, July 17, 1896, U.S.N. Herb. No. 282382; Courtney, *Bush* 814, July 31, 1900, U.S.N. Herb. No. 386725; Courtney, *Bush* 816, August 1, 1900, U.S.N. Herb. No. 286724; Courtney, *Bush* 816, August 1, 1900, U.S.N. Herb. No. 386726; Courtney, *Bush* 6006, July 15, 1910, U.S.N. Herb. No. 671725; Courtney, *Bush* 7735,

July 14, 1915, U. of Ill. Herb.; Courtney, *Bush* 9097, August 12, 1920, U. of Ill. Herb.; Dodson, *Mackenzie*, July 26, 1896, M. Herb.; Eolia, *Davis* 8727, July 23, 1916, U. of Ill. Herb.; Glencoe, *Letterman*, August, 1883, U.S.N. Herb. No. 986179; Grandview, *Mackenzie* 114, August 5, 1902, M. Herb.; Hannibal, *Davis* 103, September 16, 1900, U.S.N. Herb. No. 67935; Hannibal, *Davis* 1105, September 19, 111, U.S.N. Herb. No. 673963; Hannibal, *Davis* Acl., July 16, 1913, U. of Ill. Herb.; Hannibal, *Davis* 120, July 21, 1913, U. of Ill. Herb.; Henrietta, *Bush* 9142, August 23, 1920, U. of Ill. Herb.; Independence, *Mackenzie*, July 29, 1900, D. Herb.; Independence, *Mackenzie*, July 29, 1900, M. Herb.; Jefferson County, *Eggert* July 17, 1893, U.S.N. Herb. No. 1020784; Joplin *Palmer* 17608, August 7, 1920, P. Herb.; Lees Summit, *Bush*, 3091, July 25, 1905, U.S.N. Herb. No. 607672; Little Blue, *Mackenzie*, August 2, 1896, F. M. of N. H. Herb. No. 431340; Oakwood, *Davis* 1313, October 5, 1900, U.S.N. Herb. No. 674011; Pacific, *Eggert*, July 14, 1879, F. M. of N. H. Herb. No. 410581; Pacific, *Eggert*, July 14, 1879, U.S.N. Herb. No. 726356; Randolph, *Mackenzie* 265, July 17, 1898, M. Herb.; Randolph, *Mackenzie* 266, July 17, 1898, M. Herb.; Red Bridge, *Mackenzie* 499, September 18, 1901, M. Herb.; Red Bridge, *Mackenzie* 500, September 18, 1901, D. Herb.; Red Bridge, *Mackenzie* 500, September 18, 1901, M. Herb.; Sheffield, *Bush* 151, July 10, 1899, U.S.N. Herb. No. 392976; Sheffield, *Mackenzie*, August 29, 1897, M. Herb.; Sheffield, *Mackenzie*, July 29, 1901, M. Herb.; Sheffield, *Mackenzie* 19, July 22, 1902, M. Herb.; Sibley, *Mackenzie* 552, October 2, 1901, D. Herb.; Sibley, *Mackenzie* 552, M. Herb.; Springfield, *Standley* 9117, October 21, 1912, U.S.N. Herb. No. 688036; St. Louis, *Eggert*, July 10, 1897, U.S.N. Herb. No. 1020783; Swope Park, *Bush* 7705, July 21, 1915, U. of Ill. Herb.; Swope Park, *Bush* 7705, July 21, 1915, U. S. N. Herb. No. 837992; Swope Park, *Bush* 7716, August 6, 1915, U. of Ill. Herb.; Swope Park, *Bush* 9444, July 22, 1921, U. of Ill. Herb.; Swope Park, *Bush* 9462, July 22, 1921, U. of Ill. Herb.; Swope Park, *Mackenzie* 345, September 13, 1901, M. Herb.; Watson, *Bush* 9174, September 4, 1920, U. of Ill.

Herb.; Watson, *Bush* 9178, September 3, 1920, U. of Ill. Herb.; Watson, *Palmer* 18908, September 3, 1920, P. Hero.; Webb City, *Bush* 9078, August 8, 1920, U. of Ill. Herb.; Webb City, *Palmer* 16272, September 1, 1918, P. Herb.

IOWA

Ames, *Stewart*, month not given, 1892, U. of Minn. Herb.

WISCONSIN

Silver Lake, *Gates and Sleeper* 1813, July 25, 1907, U. of Ill. Herb.

MINNESOTA

Detroit, *Seymour*, August 20, 1884, U. of Ill. Herb.; Sandy Lake, *Sandberg* 770, August 10, 1891, U. of Ill. Herb.; Worthington, *Foote*, August, 1884, U. of Ill. Herb.

KANSAS

Lawrence, *Stevens* 49, August, 1891, U. of Ill. Herb.; Lawrence, *Stevens* 49, U. of Minn. Herb.

NEBRASKA

Neligh, *Bates* 5698, August 6, 1912, U. of Minn. Herb.; Redland, *Bates* 5662, August 4, 1912, U. of Minn. Herb.; Thomas County, *Rydberg* 1476, July 3, 1893, U. of Ill. Herb.; Valentine, *Bates*, August 7, 1912, U. of Minn. Herb., marked *E. canadensis villosus*, but leaves and sheaths only minutely scabrous. Probably the type of *E. canadensis villosus* Bates. Amer. Bot. 20: 17. 1914.

SOUTH DAKOTA

Hot Springs, *Rydberg* 1174, August 9, 1892, U. of Minn. Herb.

NORTH DAKOTA

Benton County, *Lunell*, July 7, 1901, M. Herb.; Butte, *Lunell*, July 22, 1904, U. of Ill. Herb.; Fargo Devil's Lake, *Lunell*, August 26, 1911, U. of Ill. Herb.; Fargo, *Lunell* 187, September 4, 1915, U. of Ill. Herb.; Leeds, *Lunell*, July 9, 1901, U. of Ill. Herb.; Leeds, *Lunell* 30, July 16, 1901, U. of Ill. Herb.; Leeds, *Lunell*, August 7, 1901, M. Herb.; Leeds, *Lunell*, August 11, 1901, M. Herb.

OKLAHOMA

Cleo Stevens 792, June 8, 1913, U. of Ill. Herb.; Stillwater, Bogue 478, May 28, 1896, U. of Minn. Herb.

TEXAS

Gillespie County, Jermey, date not given, U. of Ill. Herb.; Hempstead, Hall, June, 1872, U. of Ill. Herb.; Kerrville, Hitchcock 5310, June 22, 1910, U. of Ill. Herb.; Weatherford, Tracy 8115, May 31, 1902, U. of Minn. Herb.

NEW MEXICO

Dona Ana County, Wooton, July 1, 1902, U. of Ill. Herb.; Mesilla, Wooton, 19, June 16, 1897, U. of Minn. Herb.

COLORADO

Denver, Holm, July 8, 1896, U. of Ill. Herb.; Starkville, Chase 5238, September 5-11, 1908, U. of Ill. Herb.

WYOMING

Fort McKinney, Chase 5263, August 23, 1908, U. of Ill. Herb.; Sundance, Chase 5275, August 26, 1908, U. of Ill. Herb.

MONTANA

Hamilton, Chase 5192, August 1-2, 1908, U. of Ill. Herb.; Miles City, Seymour, September 3, 1884, U. of Ill. Herb.; Missoula, Sandberg 982, September, 1892, U. of Minn. Herb.

6A. ELYMUS GLAUCIFOLIUS CRESCENDUS (Ramaley) n. comb.

REFERENCES:

ELYMUS GLAUCIFOLIUS CRESCENDUS (Ramaley) Bush. *E. canadensis* forma *crecendus* Ramaley, Bull. Geol. & Nat. Hist. Surv. Minn. 9:114. (1894). *E. cressendus* (Ramaley) Wheeler, Minn. Bot. Stud. 3: 106 (1903). *E. robustus vestitus* Wiegand, Rhodora 20: 90 (1918), in great part.

TYPE LOCALITY: Springfield, Minnesota.

New Brunswick and Maine to Delaware, westward to Oregon, southward in the Mississippi Valley to Missouri, and southwest to Arizona, Wiegand, l. c. 90. 1918.

Everything in Ramaley's description points to *E. glaucifolius*, and not to *E. robustus* as stated by Wiegand.* The

* Wiegand, l. c. 90. 1918.

type specimens of *E. robustus* were glabrous, but the forms of the *glaucifolius* vary from glabrous to hirsute.

This form is distinguished from the other two forms of *E. glaucifolius* by the long, very slender, drooping spikes, and usually hirsute glumes and lemmas, but this hirsute character is very variable and is sometimes entirely lacking in some specimens. The three forms here considered all agree in having the glumes and lemmas from minutely scabrous to densely hirsute, and all three agree in having leaves that are slightly to conspicuously glaucous beneath.

It is claimed by some writers that the name *crescendus* can not be used for a varietal or specific name, as it was not used by Ramaley¹⁰ for either of these, but there can be no doubt that the name *crescendus* was firmly established by Wheeler,¹¹ and the type designated.

SPECIMENS EXAMINED:

NEW YORK

Chemung, *Lucy* 11936, U. of Minn. Herb.

CANADA

Edmonton, *White*, August 23, 1893,, U. of Minn. Herb.:
Toronto, *White* 11938, August 5, 1892, U. of Minn. Herb.

NEW JERSEY

Phillipsburg, *Small*, August 15, 1890, U. of Minn. Herb.

DISTRICT OF COLUMBIA

Washington, *Steele*, July 29, 1896, U. of Minn. Herb.

VIRGINIA

Luray, *Steele* 189, August 28, 1901, U. of Minn. Herb.

INDIANA

Millers, *Umbach*, August 14, 1897, U. of Minn. Herb.

ILLINOIS

Du Page County, *Moffatt*, August 1, 1892, U. of Minn. Herb.

¹⁰ Ramaley, l. c. 114. 1894.

¹¹ Wheeler, l. c. 106. 1903.

MISSOURI

Courtney, *Bush* 9468, July 27, 1921, U. of Ill. Herb.; Little Blue, *Mackenzie*, August 2, 1896, D. Herb.; Little Blue, *Mackenzie*, August 2, 1896, U. of Minn. Herb.; Swope Park, *Bush* 9465, July 22, 1921, U. of Ill. Herb.; Washington Park, *Mackenzie*, July 17, 1896, M. Herb.; Washington Park *Mackenzie*, July 17, 1896, U. of Minn. Herb.

MICHIGAN

Cheboygan County, *collector not given*, August 10, 1880, U. of Minn. Herb.; Jackson County, *Camp*, July 31, 1895, U. of Minn. Herb.; Jackson County, *Camp*, August 30, 1898, U. of Minn. Herb.

IOWA

Ames, *Stewart*, July 12, 1892, U. of Minn. Herb.

MINNESOTA

Crooked Creek, *Wheeler*, 292, July 6, 1899, U. of Minn. Herb.; Eagle Lake, *Sheldon* 3418, August, 1892, U. of Minn. Herb.; Glenwood, *Taylor*, July, 1891, U. of Minn. Herb.; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Hennepin County, *Oestlund*, August 13, 1888, U. of Minn. Herb.; Hennepin, County *Sandberg*, August, 1889, U. of Minn. Herb.; Humboldt, *Ballard*, August, 1900, U. of Minn. Herb.; Milaca, *Sheldon* 3300, July, 1892, U. of Minn. Herb.; Milaca, *Sheldon* 3300, July, 1892, U. of Minn. Herb.; Milah, *Skinner* 68, August 1900, U. of Minn. Herb.; Minneapolis, *Aiton*, August, 1891, U. of Minn. Herb.; Minneapolis, *Anderson* 946, date not given, U. of Minn. Herb.; Minneapolis, *Oestlund*, August 13, 1888, U. of Minn. Herb.; Montevideo, *Moyer*, July, 1894, U. of Minn. Herb.; Muskoda, *Ballard*, 3047, August 10, 1901, U. of Minn. Herb.; Muskoda, *Ballard* 3047, August 10, 1901, U. of Minn. Herb.; Northcote, *Ballard*, August, 1900, U. of Minn. Herb.; Oak Point, *MacMillan* and *Sheldon*, July, 1894, U. of Minn. Herb.; Pipestone City, *Menzel*, month not given, 1891, U. of Minn. Herb.; Red Wing, *Sandberg*, July, 1891, U. of Minn. Herb.; Rockville, *Campbell* 71, July, 1896, U. of Minn. Herb.; Springfield, *Sheldon* 1120, July, 1891, U. of Minn. Herb., type of *E. canadensis*

forma *crescendus* Ramaley; *Waconia Ballard* 765, July, 1891 U. of Minn. Herb.

NEBRASKA

Kennedy, *Bates*, August 1, 1913, U. of Minn. Herb.; Scott's Bluff, *Rydberg* 473, August 4, 1891, U. of Minn. Herb.; Whitney, *Bates* 6087, U. of Minn. Herb.

SOUTH DAKOTA

Deadwood, *Carr* 106, July 27, 1913, U. of Minn. Herb.

NORTH DAKOTA

Leeds, *Lunell*, July 8, 1901, U. of Minn. Herb.

MISSISSIPPI

Starkville, *Tracy*, July 18, 1892, U. of Minn. Herb.

COLORADO

Black Canon, *Baker* 695, August 1, 1901, U. of Minn. Herb.; Durango, *Baker, Earle and Tracy* 98L, July 18, 1898, U. of Minn. Herb.; Fort Collins, *Baker* 8778, August 23, 1894, U. of Minn. Herb.

WYOMING

Albany County, *Nelson* 7600, July 16, 1900, U. of Minn. Herb.; Fairbanks, *Nelson* 552, July 15, 1894, U. of Minn. Herb.; Fort Laramie, *Nelson* 9191, July 25, 1908, U. of Minn. Herb.

MONTANA

Gallatin, *Rydberg* 2287, July 29, 1895, U. of Minn. Herb.; Sand Coulee, *Anderson*, August, 1881, U. of Minn. Herb.

IDAHO

Shoshone, *Nelson and MacBride* 1189, July 19, 1911, U. of Minn. Herb.; Sweet, *MacBride* 1630, August 14, 1911, U. of Minn. Herb.

WASHINGTON

Alma, *Elmer* 518, July, 1897, U. of Minn. Herb.
6B. ELYMUS GLAUCIFOLIUS ROBUSTUS (Scribn. & Smith) n. comb.

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REFERENCES:

E. GLAUCIFOLIUS ROBUSTUS (Scribn. & Smith) Bush. *E. robustus* Scribn. & Smith, Bull. Div. Agrost. 4: 37. (1897); Nash, Britton, Manual, in large part, 157 (1905); Hitchcock, A. Gray, Manual, in large part, 169 (1908); Nash, Small, Flora, in large part, 160 (1913); Wiegand, Rhodora 20: 89 (1918) in large part. *E. canadensis* L., Palmer, Flora of Jasper County, Missouri, in part, 365 (1916). *E. canadensis robustus* (Scribn. & Smith) Mackenzie and Bush. Manual of the Flora of Jackson County, Missouri, 38 (1902). *E. brachystachys* Scribn. & Ball, Bull. U. S. Dep. Agr. 24: 47 (1901); Nash, Britton Manual, 2nd ed. Suppl. 1054 (1905); Hitchcock, A. Gray, Man. 7th ed. 169 (1908); Nash, Britton & Brown, Ill. Flora 1: 2nd ed. 293 (1913); Palmer, Flora of Jasper County, Missouri, 365 (1916).

TYPE LOCALITY: Illinois, Iowa, Kansas and Montana.

Illinois, Michigan, South Dakota, Montana, Kansas to New Mexico, Texas and Mexico, Nash, l. c. 157, 1905.

Illinois to Michigan, South Dakota and Mexico, Hitchcock, l. c. 169. 1908.

Illinois to Arkansas, Montana and Kansas, Nash, l. c. 160. 1913.

Michigan, Alberta, South Dakota, Missouri, Texas and Mexico, Nash, l. c. 293. 1913.

Illinois and Michigan, to Montana, Colorado, Iowa, Missouri, Ohio, Texas, New Mexico and Arizona, Wiegand, l. c. 89. 1918.

There can be no doubt that this plant is only a form of *E. glaucifolius*, but as long as it can be distinguished in the field and the herbarium, it should be distinguished by some name, and I am therefore assigning it varietal rank under *E. glaucifolius*. Nash had already reduced this species to *E. canadensis* (i. e. *E. glaucifolius*) in the Illustrated Flora, and Wiegand in his paper included both *E. glaucifolius* and *E. robustus* under the latter name, and cites localities that proves that he had both forms in hand at the time. It may be generally distinguished from the other two forms of *E.*

glaucofolius by shorter, stouter spikes, which are thicker, and but little nodding at the apex.

SPECIMENS EXAMINED:

MISSOURI

Courtney, *Bush* 9467, September 27, 1921, U. of Ill. Herb.; Floyd, *Bush* 9399, July 11, 1921, U. of Ill. Herb.; Floyd, *Bush* 9403, July 11, 1921, U. of Ill. Herb.; Floyd *Bush* 9404, July 11, 1921, U. of Ill. Herb.; Floyd, *Bush* 9405, July 11, 1921, U. of Ill. Herb. Floyd, *Bush* 9406, July 11, 1921, U. of Ill. Herb.; Sheffield, *Bush* 9385, July 8, 1921, U. of Ill. Herb.; Sheffield, *Bush* 9389, July 8, 1921, U. of Ill. Herb.¹²

IOWA

Muscatine, *Mackenzie* 690, August 8, 1894, M. Herb.

KANSAS

Nearman, *Mackenzie*, July 7, 1897, M. Herb.; Rosedale, *Mackenzie*, July 12, 1896.

TEXAS

Dallas, *Reverchon* 1140, May 26, 1900, M. Herb.

¹² Specimens collected in northeastern Missouri by Davis, were sent to Hitchcock for identification, who determined them as *E. diversiglumis*, but I have seen no specimens from anywhere near this state that are that species, which seems to range from Wisconsin and Minnesota to North Dakota and Wyoming.

REPORT ON THE STUDY AND APPRAISAL OF MUSSEL RESOURCES IN SELECTED AREAS OF THE UPPER MISSISSIPPI RIVER, 1920-25.*

N. M. GRIER.

DARTMOUTH COLLEGE HANNOVER, N. H.

I.—INTRODUCTORY.

During the months of August and September, 1925, the U. S. Bureau of Fisheries repeated a study and appraisal of the mussel resources in certain selected areas of the Upper Mississippi River, originally made in July and August, 1920. Both investigations were carried on with reference to legislation on the part of the States of Wisconsin and Minnesota which provided for the closure of certain of these areas for the protection of the fresh water mussels during a period of five years, as well as for areas to remain subject to fishery. The data acquired in 1920 was expected to form a basis for comparing the conditions of that time with those of 1925, after a period of protection.

In 1920, the area studied began at a point about five miles above Red Wing, Minnesota, extending thence through Lake Pepin, and ending nearly 80 miles down stream at La Moille, Minn. In 1925, however, it was arranged that Mr. J. B. Southall, of the Bureau of Fisheries, undertake the bulk of the survey work in Lake Pepin, so as far as the work of the my party was concerned in 1925, the more productive areas of the lake were omitted. The regions studied by Mr. Southall are indicated in the report for 1920 as Areas IV and V. During this investigation, Messrs. R. H. Young, of the Northwestern University Medical School, and Leonard Loeding, of Lake City, Minn., served as assistants.

For a fuller account of the work of 1920 see Final Report on the Study and Appraisal of Mussel Resources in Selected Areas of the Upper Mississippi River. Amer. Mid. Naturalist, Vol. VIII, No. 1, Jan. 1922.

* Published by permission of the Commissioner of Fisheries, Washington, D. C.

II.—GENERAL CONDITIONS IN THE AREAS IN 1925.

While in 1920, the river at the time of investigation was in a flood stage of from 2-9 ft., the opposite conditions prevailed in 1925. Government engineers at Fountain City stated that with the exception of a lower stage noted in September, 1923, the stage during which we worked was the lowest since 1864, and varied from 3 ft. above to 3 ft. below zero* during the period between Aug. 15 to Sept. 15. The normal low water stage for the river during August and September is from 2-2½ ft. above zero.

The general effect of this condition was to cause a migration of the mussels toward the channel, which fact had to be taken into account in relocating the stations appraised in 1920. In many cases throughout the region covered by the survey, mussels large and small were observed to be dead and dying as a result of inability to move with the water as it fell. Snags were fully as abundant in the river in 1925 as in 1920. From the clammer's standpoint, the time of the survey in 1925 was not a propitious one. Their contention is that during the normal low water period of August and early September, the mussels burrow in the mud and are not easily taken with the apparatus used by our party, shortly to be described. It is true that some species of mussels burrow in the mud, but such is liable to occur at any season of the year when the substratum does not give sufficient support, and when the mussels are unable to move as the water falls. What may occur to explain the scanty returns secured by clammers in that part of the season is that the clam bed as such is fairly well clammed out by that time, and the remaining shells are so scattered as not to be readily caught under the conditions. Then, when left alone, the beds may gather other shells as they are swept in by the current or migrate from unfavorable conditions elsewhere. At Red Wing, for example, we secured fair hauls of shells from a depth of 2-4 inches of mud. At

* Inspector C. G. Weyl, U. S. Engineers, Fountain City, Wisconsin, furnishes the following information in connection. "The term zero is based on the low water stage of 1864, and the elevation of zero is 644-5 ft. above sea level."

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Wabasha, our returns from crow-foot bars were very scanty, yet a young woman had collected a considerable number of shells by hand that same day in the vicinity of our drags. If the clams naturally require a rest at that period of the summer and thus are compelled to go down in the mud, this young woman, as well as our party in the work to be described, would have had difficulty in securing returns. Additionally we secured shells at Teepeeota Point through several inches of water weed.

In the report on conditions in 1920 it was indicated that the proportions of mud and sand in the river bottom increase perceptibly in the vicinity of the tributary streams of the region, and it was stated that the Chippewa river was largely responsible for the enormous quantities of sand brought into the areas surveyed by the party below Lake Pepin. Mention was also made of the fact that only through the construction of wing dams, (formerly of stone, but now of stone, brush, or even sand), have the government engineers been able to preserve a navigable channel in the regions surveyed by the party. These dams are designed to catch the sand near mid-stream, deflecting it toward the shore where it ultimately forms sand bars and islands, but it unfortunately at the same time smothers the valuable clam beds which formerly existed in these regions, with the consequent discouragement of the clamming industry.* While the Engineering Corps is administering what will undoubtedly constitute a cure for the conditions they find, the writer is impelled to point out that co-ordinated action in reconstructive conservative measures at the present time, may eventually lighten the burden of the separate agencies working upon the various phases of conservation of our natural resources.

The situation and the method of meeting it is described

* According to Inspector C. G. Weyl, U. S. E., Fountain City, Wisconsin, these wing dams are built to a height of 4½ ft. above low water stage, except for 6 miles above Winona, Minn., where they are from 7 to 7½ ft. above. In that portion of the river with which we are concerned, the width of the river from the end of the dams to the opposite shore is 525 ft. Below Winona, however, this width is 625 ft.

from the engineering standpoint in the following letter, dated Oct. 22, 1925, from Major C. F. Williams, U.S.E., District Engineer of the region in which the survey was made:

"Except for the rapids at Rock Island and Keokuk the upper Mississippi River from the Twin Cities to the mouth of the Missouri River is characterized by flat low water slope, gentle current, bed of sand and gravel, and banks from eight to fifteen feet high. The channel consists of alternate pools, ten to twenty feet deep, and shoals which in low water formerly had a depth sometimes as small as one or two feet. The pools occur in the bends while the shoals or bars are in the straight reaches where the channel crosses from one bank to the other, hence their designation as "crossings."

With the completion of the early improvements by the Federal Government in 1877 of the rapids mentioned above, the attention of the engineers was turned to the improvement of the depths over the crossings and since 1878 the scheme now in use has gradually developed.

In a stream with an easily eroded bed such as the Upper Mississippi, the depth is roughly inversely proportional to the width, and on this simple principle is based the scheme of improvement. Back sloughs and secondary channels are closed by low dams of rock and brush, (closing dams), so as to concentrate the entire low water flow in the main channel, and in places of excessive width the main channel is contracted by building dams of similar construction, (wing dams), out from one or both banks. In addition the channel is cleared by snagging and dredging, and banks subject to attack by erosive currents are protected by means of rip rap.

The above improvements were first designed to give a least depth of 4½ feet at low water and later to give 6 feet.

The following table shows the number of wing and closing dams built in the various sections in which you are interested:

OUR AREAS	Total dams completed	
	by the fall of	
	1920	1925
VII. (a) Read's Landing to Minneiska, Minn.....	255	257
VIII. (b) Minneiska, Minn., to Fountain City, Wis. 130	130	139
IX. (c) Fountain City, Wis., to Winona, Minn.....	83	83
X. (d) Winona, Minn., to La Moille, Minn.....	98	98

As you will notice, very few new dams have been placed in the past five years, nor are many more projected. Our work now consists largely in repairs and extensions to existing dams. Channel dredging of course goes on each year in various localities."

The information in the above letter which has the greatest bearing on the conservation of the mussel resources of this region is that the number of dams has increased in two of the areas surveyed by the party in 1920-1925. These are Area VII—Read's Landings to Minneiska and Area VIII, Minneiska, Minn. to Fountain City, Wis. The possible effects of these improvements upon the mussel beds of those areas will be brought out in the discussion of each of them. In this connection another letter of Major Williams under heading of Sept. 12, 1925, is of interest:

... "You are informed that the works of regulation authorized between Diamond Island and La Moille have not been completed. The length of time necessary for the return of the river to its normal conditions after the construction of works of contraction is a variable depending on numerous conditions, a few of which are stages, conditions of reaches above and below and under improvement, method of improvement, and length of reach under improvement. However two years may be considered on the average. The construction of wing dams is still being carried on below Prescott, Minn. Above Prescott, that work has been suspended indefinitely until the matter of improvement by locks and dams has been settled."

From the second letter it seems evident that two years after the present authorized improvements have been completed, the river bottom may commence to return to conditions under which clams may prosper. No date is indicated as to when the works below Prescott, Minn., will in most probability be completed, and it is difficult to indicate the effect upon the clam beds, if these proposed improvements of the river above Prescott are carried through. Such conditions must necessarily be considered in any plans for the restocking with mussel life of depauperated sections of the river.

III.—STATUS OF THE MUSSEL FISHERIES IN RELATION TO THE PRECEDING.

That stretch of the river about five miles northwest of Red Wing in the vicinity of Diamond Island, and which is known to old-time clammers as the Trenton Bed, was little worked in 1920, but the whole region had been extensively clammed during the past 3-4 years. In 1925, nine rigs were in operation in the Red Wing region. Clammers estimated that 45-50 tons of shells had been produced, selling at \$42.50 per ton. The record pearl secured was one of 45 grains. However, the complaint of the clammers was that the region had been extensively polluted by refuse from the St. Paul slaughter houses, rendering clamming operations unattractive. This pollution they observed as early as spring in the year.

Coincident and perhaps correlated with the disappearance of the enormous number of fish formerly seined at the head of Lake Pepin, is the diminution of the mussel resources of the region, Area III. At any rate mussel fishing in this region is considered unprofitable, although mussels are abundant just outside the lake in the river channel. About three and one-half miles from the head of Lake Pepin, we encountered two men and two women picking shells from a depth of about 3½ ft. of water. Although this was in a closed area, they did not have the impression that it was illegal to pick clams by hand. They stated that they could pick 10 bucketfuls per day, which at the rate of 70 bucketfuls to a ton would be worth over \$3. One clammer had a 25-grain pearl, another, one of from 45-50 grains. Near Maiden Rock bluff, we also met three clammers, who were operating in the river above Lake Pepin. One reported 15 tons of shells thus far for the season's work, but he had collected only about \$10 worth of pearls in two years!

The conditions encountered in the more productive part of Lake Pepin during the summer are best dealt with in the report prepared by J. B. Southall. Our work there was resumed in what will be referred to as Area VI, whose northern boundary is a line drawn between Pepin and King's Coulee. At that time, Aug. 26, we observed a number of rigs lying

idle at Pepin, and observed one rig to put in after a short try for shells. At the foot of Lake Pepin, the low stage of the water permitted three clammers to capture mussels with pitchforks. Still another clammer was altruistically removing dead shells with the living ones, on the theory that their presence was harmful to the latter. Nine rigs were observed standing idle at Read's Landing. No pearls were reported to us from this section.

Clammers had been active in the vicinity of Wabasha since 1920, but we saw no rigs. However, the morning we were there as previously noted, a girl picked up seven bucketfuls of commercial shells in that period, but this was exceptional. Above the railroad station at Alma, we observed a pile of about 100 shells, principally niggerheads, pimple backs and pigtoes which had evidently been taken from the water by pitchfork or by hand for the pearls they contained. This was the sole activity in evidence from Read's to Minneiska. So far as our observations go, the few remnants of formerly extensive clam beds at or near Wabasha, Minn., Teepeeota Point, Alma and Fountain City, Wisconsin, and Minneiska, Minn., which we found in 1920, have practically disappeared or are in the process of extinction. The Wabasha bed was clammed out when we studied it this summer, but as it is favorably located, it would probably, if specially protected, regenerate rather rapidly. Dams constructed at Teepeeota Point and the rapidly growing water weed are slowly causing this section of the river to fill in and smother the clams. At Alma, it was found that a government barge laden with stone had sunk in the bed north of the Burlington Station, and that not all this stone had been recovered from the bottom. The clams which may remain in the bed are available only to hand pickers. Further down opposite the center of the town, we found that government engineers had dredged the channel the preceding year, pumping the sand over to the opposite river bank. This utterly destroyed our locality VII-14 of 1920. Exactly the same thing occurred at Fountain City, this summer, while we found that at Minneiska, above Fountain City, additional dams con-

structed in that vicinity, had deposited sand and silt on the remnant of the bed we found there in 1920.

In the report for 1920, it was suggested that the preceding beds, persisting as they had under unfavorable conditions for a number of years, offered fairly suitable conditions for restocking, since the older shells afforded some lodgment for younger ones until they could more readily resist the flow of the current. It is evident however that when such beds are destroyed outright or rendered inaccessible for fishery, that some loss to the mussel resources is occasioned. As first reported in 1920, stream pollution is still extensive at Alma, Fountain City and Minneiska, and if such no longer can effect the local clam beds, it may eventually cause damage to those further down stream, or inhibit the appearance of the older ones through the indestructible nature of the rubbish deposited upon them.

As a general rule, mussels were less numerous in the vicinity of sand bars created by dams in 1925 than in 1920. This of course, may have been the result of the contrasting conditions in the river during the summer and that of 1920. Where, however, sand bars in certain of the sloughs were explored, mussels were found to be quite numerous. In the river sand bars, the following species were most abundant in order: *Fusconaia undata*, *Ambelma peruviana*, *Lampsilis ventricosa*, *Lasmigona complanata*, *Obliquaria reflexa*, while in the sloughs they were as follows: *Ambelma peruviana*, *Fusconaia undata*, *Lampsilis ventricosa*, *Obovaria olivaria*, *Prop-tera laevis*.

In many cases pockets of shells were discovered in the mud and sand accumulating between the dams. Such is represented by our locality VIII-14. At other times they were found in the ponds formed by high water behind the normal shore line. Near Fountain City we met a fish rescue crew from Homer under H. P. Fellgate, which had just removed 2-3,000 game fish under five inches in length from such a pond 175-200 ft. in length, with an average width of from 10-12 ft. With a total of seven people collecting by hand there were removed from this pond in half an hour a total of 374 living

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mussels, of which over four-fifths were commercial species of a marketable size. These shells were restored to the river at this point. While their market value may not have justified the efforts of the average clammer, on the other hand the reproductive potentialities of these animals in a region scarce of mussel life is much greater. In 1920, it was recommended that mussels be taken from the sandbars by hand when desirable for commercial purposes, and that when in danger of stranding, these creatures be given the same conserving care as fish receive in the rescue work. Such a recommendation is extended to mussels found trapped in such ponds or anywhere where their life is in danger of curtailment. The two localities stocked with shells in 1920 by the party, which they had removed from the sandbars with the view of rechecking these localities in 1925, were found to be completely covered with sand.

As in 1920, the sloughs of the river below Lake Pepin and above Winona appeared to be richer in mussel life than the main river. Belvedere and Straight Sloughs are still good shell producers, although the latter, as will shortly be described, is in danger of depopulation of its mussel life. West Newton Chute at its upper end is now completely blocked off from the main river by sand pumped in by the engineers and while we found a few shells there, the slough is slowly filling up. The party made one of the best hauls of the trip at the lower end of the slough, (Loc. VII.-22) but here the bottom is principally mud, and it can not be long before the slough becomes inaccessible from the rivers for clammers, and ultimately only the more unprofitable, mud dwelling shells will survive. The low stages of the river prevented the use of crowfoot bars in these sloughs, and all records of them for 1925 are of the party picking by hand.

We entered the Straight Slough overland, from the vicinity of Winona, as the stage in the water was so low that we were unable to enter it with the boat. On the way we observed one clammer picking by hand in a branch of Crooked Slough and saw a pile of about two tons of commercial shells. Due to the low water stage, Crooked Slough was also crossed

by land, and we saw hundreds of dead shells where they had perished *in situ* as a result of the drought. Reports had reached us concerning the extent of the clamming operations during the summer in this region, and while some were obviously exaggerated, it is perfectly true that the low water deprived the mussels of some of their natural protection, and permitted far more of them to be taken than would be the case under ordinary circumstances. As will be more fully discussed later, young children were engaged in the work. Of course such a period of drouth but rarely occurs, but there is suggested immediately a legal limitation to the depth of water from which living clams may be taken under such conditions. Lack of such is conducive to the violation of the protective laws as will be clearly shown.

The party re-explored Straight Slough in a row-boat to the sites of the localities studied in 1920. Four men, and in some cases their families, were reported to be clamming in Straight Slough, which had more dead shells in its water and along its banks and more living young shells than any other section of the Mississippi studied. At Mr. Kline's place there were observed 3 tons of shells collected in two weeks' time from an inlet near his home, five-eighths of a mile long and 30 ft. wide. The pile contained yellow sand shells, three ridges, white heel splitters, bull heads, long johns, pink heel splitters, and spikes. The four children of this family picked by hand on the father's license. The family had collected only a few slugs, and expected to receive only \$25 per ton for their shells under the opportunistic methods adopted by the shell buyers. The Klines reported an abundance of shells in Bartlett's Lake nearby. At Mr. McNally's place, a ton of shells had been collected by three children of the family. He reported one pearl selling for \$25. In his pile we saw a dead specimen of *Quadrula granifera*, the first seen on the trip, while in the slough we saw our first specimen in 1925 of the bullhead, *Pleurobema aescopus*.

Above our locality IX-22 is located Sandy Creek which at high water connects Crooked Slough and Straight Slough. It was very nearly dry except at its mouth, and at about 50

yards covered the channel the same as the sand than but out except might

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yards back from the latter the former bottom was thickly covered with dead shells extending back about 100 yards in the channel. These shells gave indication of being buried by the sand or killed by some previous low water stage, rather than being taken and cut open for pearls. They were without exception, have grade shells for commercial purposes, and might have been conserved by rescue work.

As in 1920, we found that portions of Straight Slough and Belvedere Slough appeared to be favorable to the growth of shells as judged by the number of juvenile shells occurring here. With the exception of occasional small piles of shells evidently cut open by pearl hunters, the mussel resources of Belvedere Slough have not attracted clammers. As these sloughs are fed to some extent by local drainage and at places have a fairly rapid current, it is evident that even if they are filling up they will for some years offer a congenial environment to mussels, and may be a convenient source of material for propagation work below Lake Pepin. Additionally they present favorable places for restocking. When it is recalled that they are also the principal spawning grounds of fish from the river, it would seem perfectly clear that special legislation or administrative action in protecting them from exploitation is justified. Such action was taken in the case of Straight Slough during the past year when it was closed to seining by the Game Commissioner of the State of Minnesota. Under the conditions of low water described such an action would be justified for the protection against over-fishing of fresh water mussels.

It is worthy of note that in the vicinity of Winona there exist the most extensive clam beds occurring in the river between that city and Lake Pepin. It is remarkable also that the sand bars of the vicinity yield good returns on picking with the greatest abundance of juvenile shells. Presumably in this region the bottom conditions are favorable toward forming a clam bed, but it is the impression of the writer that further up the river there exist equally good places but with few or no shells. While mussels are thinly scattered in the river above Winona, they are still comparatively plentiful in

the parallel Straight Slough. Possibly the bed at Winona is so favorably located that it has but little trouble in keeping up a fair degree of regeneration, but the presence of many shells, mature and juvenile, on the sand bars of the vicinity suggests that the effects of the current are such that the bed may receive many shells from up stream. Now as the most bountiful and immediate supply of shells is in Straight Slough which opens into the Mississippi about half a mile above Winona, there is a strong probability that many shells find their way into the Mississippi at this point. If experiment shows this to be the case, we have an additional argument for the application of more stringent protective laws to the mussels of the sloughs.

Near Homer, Minn., below Winona, we encountered 3 clambers "frogging it," as they term picking by hand and the best information had was that six or eight clambers had worked the beds in the vicinity of Winona that summer. Clamming in this region was reported to have increased considerably in the past three years.

Reasons, then, commonly assigned in 1920 within the regions surveyed for the depletion of the mussel resources, and the consequent decline of the clamming industry are still found to hold in 1925, viz.:

1. The smothering of the mussel beds by sand deflected by the dams as already indicated. Additionally, it may be stated that the increased velocity of current thereby insured has the probable effect of sweeping juveniles just dropped from fish, or more mature mussels, long distances down stream, or to lodge them upon sand bars where they may be covered up unless specially rescued.

2. Destructive fishing methods such as taking very young shells, deliberately clamming out beds and fishing with the shoulder rake are also responsible. Favorable sentiment toward respecting the protective laws is characteristic of the professional clammer, but still a great deal of damage is done by the occasional or less experienced fishermen who in many cases submit immature shells to the buyers. According to the clambers, the latter make the situation worse by accept-

ing them. Under this category there may also be included the cases mentioned where more than one individual clams on a single license, and where conditions of extremely low water permit the clams to be picked in greater numbers than under ordinary circumstances.

3. The growth of formerly extensive clam beds near communities situated along the river has been inhibited by the pernicious practice of dumping rubbish of somewhat indestructible nature in the river at these localities. While State laws are also clear on these points the enforcement of them seems largely a matter of local sentiment. The *hinterland* of the regions involved is still so productive that it seems difficult to arouse the people to the relation of this practice to the conservation of all aquatic resources.

To these may be added a fourth reason due to the lack of a correlating factor between different agencies of the government working for conservation—that of the destruction of clam beds by channel dredging activities. The writer at present finds it impossible to say whether the clams now destroyed by this practice could be conserved by any ready means.

When the preceding data on general conditions in the areas and the status of the mussel fisheries are considered in entirety, it becomes evident that before the mussel resources of these areas can be improved, some practicable basis must be determined from which measures looking forward to their fullest protection and conservation can be inaugurated. A study of this nature then will show when and where this is likely to be obtained by the enactment of protective laws, and when, where, and why such are likely to fail in bringing results as fast as might be anticipated. Such data is also apt to be useful for the future guidance of this branch of conservation activities. Hence the reason for this study and appraisal of mussel resources in certain areas of Wisconsin and Minnesota, the region in which a large percentage of the commercial shells are produced.

IV.—METHODS.

(a.) Description of Outfit for Collection of Shells.

The work was approached from the standpoint of the mussel fisherman, a bar and crowfoot outfit, (john boat), being used to collect the shells. The outfit was towed from place to place by a Government launch. In the areas in and above Lake Pepin, (I-VI. inc.) 100 hooks were attached to each of the 16-ft. bars. Below Lake Pepin, starting at Read's Landing, (areas VII-X inclusive), the river bottom is heavily infested with snags, so the bars were shortened to 10 ft. with a consequent reduction in the number of hooks on each to 75. In the first named areas, the data forming the basis of the conclusions presented, comprises the results of three trials of the same length of drag with the bars, (300 ft.), at each of the localities indicated. In the remaining areas, the number of drags was increased from three to four, to compensate for the reduction in the number of hooks, but otherwise the procedure was the same. Additionally, the john boat had at its bow, a hand windlass bearing three hundred feet of five-eighths inch line, to the free end of which an anchor was attached. In proceeding from one locality to another, the windlass was locked, and the boat towed by a separate piece of rope.

(b.) Collecting Mussels for Study and Appraisal.

When it was decided to appraise a particular locality, a starting point was determined by methods shortly to be described, the windlass and the tow-line were released, and the launch going ahead unreeling the 300 ft. of line into the water until it was very nearly taut, when the operator of the launch dropped the anchor at the free end. For the purpose of temporarily anchoring the john-boat while the line was being payed out, one of the bars, usually that one to be placed to the rear, was at favorable opportunity, dropped into the water in such a way that it lay at right angles with the shore, and dragged parallel to it. When it had touched bottom, it was seoured into position by means of props and by knotting its rope around one of the uprights. As soon thereafter as the boat had swung into a favorable position to render less likely

the entangling of the hooks of the bars, the remaining bar was dropped and secured likewise.

After the anchor was dropped and the bars properly spread, one of the two operators in the john boat windlassed the latter by slow and steady turns up to the point where the anchor had been dropped, observing from time to time the relative apparent motion of the shore line to make certain that snagging or fouling of the bars was not causing the john boat to pull the anchor towards it in the meantime. When such was found to be the case, the bars were pulled up, the catch discarded and a new trial made. When the john boat had been properly windlassed up to the anchor, the latter and the bars were pulled up, the mussels taken off the hooks and thrown into a tub. The launch then towed the john boat back to the original starting place, when this procedure was repeated twice again for each locality, the mussels obtained from the 3 trials being counted together. Dead shells obtained were recorded separately. Other biological specimens obtained through this procedure were sent to various specialists for identification, and the results of their work which is hereby gratefully acknowledged, is comprised in the notes on the various areas. The special dredge carried by the party in 1920 to determine the conditions on the bottom of the river, and for the purpose of securing material for a special study of juvenile mussels was not used in 1925, as there seemed to be no special reason for obtaining additional data of this type.

(c). Determination of Localities.

The course of the river was followed by means of a set of maps of the river published by the Mississippi River Commission and by a copy of the current edition of the light list for the 13th Lighthouse District as in use by navigators on the river in 1920 and 1925. Comparison of these indicated the extent to which the Government Day marks used as land marks in the investigation had changed in position during the past five years. The position of each locality surveyed is indicated on the maps used, which are now in possession of the U. S. Biological Station, Fairport, Iowa. On these maps, the

localities are numbered according to area, and to the order in which they were examined. Thus I-3 on the map indicates Area I and the third locality in it. References to the data to follow should be similarly understood. As previously indicated, only the three best localities in each area are reported upon.

It was not found practicable to draw into the maps these localities on an exact scale. The markings largely indicate the relative position of the locality with regard to the shore line at the time, the more absolute one being obtained by reference to the descriptive material given in connection with the marking on the maps. The more absolute data concerning the position of the locality was obtained by reference to some object or formation along the shore which seemed of a fairly permanent nature, such as the Government Lights or Day Marks or other improvements along the river, ravines, elevation of adjacent hills, clumps of bushes, trestles, etc. The first two types of reference points were not used when anything better could be observed. The light list referred to gives the distance of these marks and lights from more accurately defined points such as bridges, etc. As data furnished by local clammers was sometimes found to be misleading, positions of productive shell beds were frequently determined by a trial drag with a single bar at varying distances from the shore, when, after encouraging results, the three consecutive drags with both bars were attempted. All beds of shells of fair extent which the party encountered are also indicated upon the maps mentioned.

Once the reference point was established, the distance across the water of the starting point of the drag from this was estimated independently by the three members of the party. The average taken of these distances is that one given in the descriptive material of the localities and in case of great variation in estimate, the more probable distance was verified by measurement of other points on the map within sight and by the making of comparisons. A map case of the type used in the U. S. Army provided with compass and transparent water proof cover was found to be a convenient carrier for the maps in the field, and on it the localities could be promptly

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located. A spring back aluminum binder was found to be serviceably adaptable for holding the mussel survey sheets used for the recording of data. It should be born in mind, however, that as the larger portion of the work was accomplished under conditions of low water in 1925, it was difficult to accurately estimate the position of the normal shore line, and the distances given are those of the position of the outfit from the nearest land above water at the time.

V.—LIST OF SPECIES COLLECTED.

The following list embraces those species of mussels collected within the areas surveyed.* Besides indicating the common name by which mussels are known to clammers, the older scientific names of Simpson's Descriptive Catalogue of the Naiades are given, and their equivalent in the recent Pilsbry-Ortman-Walker nomenclature, which follows more closely the rules of modern taxonomy so far as they concern the mussels.

* For a complete list of the Naiades of the Upper Mississippi Drainage see Grier, N. M., *Nautilus*, 36.

COMMON NAME		SCIENTIFIC NAME	
Commercial Species		After Simpson	After Pilsbry, Ortmann & Walker
Niggerhead		Quadrula ebenus	Fusconaia ebena (Lea.)
Niggerhead		Quadrula solida	Pleurobema catillus (Con.)
Hickory Nut		Obovaria ellipsis	Obovaria olivaria (Raf.)
Pimple Back		Quadrula pustulosa	Quadrula pustulosa (Lea.)
Maple Leaf		Quadrula lachrymosa	Quadrula quadrula (Raf.)
Monkey Face		Quadrula metanevra	Quadrula metanevra (Raf.)
Purple Pimple Back		Quadrula tuberculata	Rotundaria granifera (Lea.)
Three Horn Warty Back		Oblivaria reflexa	Oblivaria reflexa (Raf.)
Pig Toe		Quadrula undata	Fusconaia undata (Barnes)
Blue Point		Quadrula plicata	Ambelma peruviana (Lam.)
Three-Ridge		Quadrula undulata	Ambelma costata (Raf.)
Wash Board		Quadrula heros	Megalonaia heros (Say.)
Buck Horn		Tritogonia tuberculata	Quadrula verrucosa (Raf.)
Mucket		Lampsilis ligamentina	Actinonais carinata (Barnes)
Higgin's Eye		Lampsilis higginsii	Lampsilis higginsii (Lea.)
Lake Pepin Mucket		Lampsilis luteola	Lampsilis silicoidea (Barnes)
Butterfly		Plagiola securis	Plagiola lineolata (Raf.)
Deer Toe		Plagiola elegans	Amygdalonaia truncata (Raf.)
Pocket Book		Lampsilis ventricosa	Lampsilis ventricosa (Barnes)
Yellow Sand Shell		Lampsilis anodontoides	Lampsilis anodontoides (Lea.)
Slough Sand Shell		Lampsilis fallaciosa	Lampsilis fallaciosa (Smith.)
Black Sand Shell		Lampsilis recta	Eurynia recta (Lam.)

Bull Head ----- Pleurobema aescopus ----- Plethobasus cyphus (Raf.)

Black Sand Shell	<i>Lampsilis recta</i>	<i>Pleurobema cyphus</i> (Raf.)
		<i>Eurynia subrostrata</i> (Say.)
		<i>Lasmigona complanata</i> (Barnes)
		<i>Lasmigona costata</i> (Raf.)
		<i>Prostera alata</i> (Say.)
		<i>Arcidens confragosus</i> (Say.)
		<i>Elliptio niger</i> (Raf.)
		<i>Elliptio dilatatus</i> (Raf.)
		<i>Pleurobema pyramidatum</i> (Lam.)
		<i>Alasmidonta marginata</i> (Say.)
		<i>Amygdaloniais donaciformis</i> (Lea.)

NON-COMMERCIAL SPECIES

F'leater	<i>Anodonta grandis</i>	<i>Anodonta grandis</i> (Say.)
Slop Bucket	<i>Anodonta corpulenta</i>	<i>Anodonta corpulenta</i> (Cooper)
Paper Shell	<i>Anodonta imbecillis</i>	<i>Anodonta imbecillis</i> (Say.)
Squaw Foot	<i>Strophitus edentulus</i>	<i>Strophitus edentulus</i> (Say.)
Paper Shell	<i>Lampsilis gracilis</i>	<i>Leptodea fragilis</i> (Raf.)
Paper Shell	<i>Lampsilis laevisissima</i>	<i>Proptera laevisissima</i> (Lea.)
Snuff Box	<i>Lampsilis parva</i>	<i>Carunculina parva</i> (Barnes.)
(No common name)	<i>Truncilla triquetra</i>	<i>Truncilla triquetra</i> (Raf.)

VI.—RESULTS AND OBSERVATIONS.

These include data compiled upon the absolute and relative abundance of each species of mussel found in the areas appraised, together with such geographical or other information likely to be of use in expediting the rechecking of these results after a period of protection, or which might have a bearing upon propagation experiments. The number of shells of each species collected in each locality is given under the heading of the latter, and the percentage of this in the total catch in the locality is indicated. The average of the three percentages thus obtained for each species in each area is taken to represent the relative abundance of that species in the area. An asterisk indicates that the species was found to be less than 1% in the area and locality involved. A blank space opposite the name of a species indicates that living shells were not collected in either the area or the localities of it.

AREA I.

Boundaries, lower half of Diamond Island, Miss. R. to Red Wing, Minn., at high bridge. Status, open to fishery in 1920, closed in 1925. Length in linear miles 4.2. Physical conditions, 1920, estimated 7-8 ft. high water. Current, about 5 miles per hour. Bottom mostly gravel and sand. Middle sections of area infested with snags. Water at least 5 ft. below normal stage in 1925.

Localities Reported Upon. (Ref. Maps.)

1-1. Starting point of drags Government Day Mark 958-n near center of Diamond Island, 25 ft. from shore on Minnesota side of channel. July 7, 1920. Aug. 19, 1925, bottom covered with decaying organic matter. Drags 5, 15, 25 ft. from the shore.

1-2. Starting point of drags Government Day Mark 958-k, (above island 23), on Wisconsin side of channel, 30 ft. from shore, about one-half mile down stream from the preceding locality, July 7, 1920. Aug. 19, 1925, bottom covered with decaying organic matter. Drags 15, 25, 50 ft. from shore.

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1-6. Starting point of drags 300 ft. upstream from Government Day Mark 958-g across the mouth of a slough about one mile above Red Wing on the Minnesota side, 50 ft. from the mouth of the slough. July 9, 1920. Aug. 20, 1925, slough largely filled up, bottom muddy, water weeds growing out from the shore. Drags 10, 25, 40 ft. from the shore.

Notes on Area I.

Rotundaria granifera, reported absent from this area in 1920 was not collected by us here in 1925 if it has reappeared, while our northernmost record for *Arcidens confragosus* was obtained near Trenton village.

A marked decline during the past five years was noted in the absolute abundance of mussels in this area,* which is not surprising in view of the fact that the region was extensively clammed during the past few years, and has also been subject to extensive stream pollution. As regards the relative abundance of shells in this area it was observed for commercial species that there was an appreciable increase in the number of pimple backs, pigtoes, blue points, buckhorns, pocket-books and a decrease in hickory nuts, river muckets, Lake Pepin muckets. This decrease is seen to concern the more

* EDITOR'S NOTE: As it has been found impracticable to reproduce with the manuscript the statistical tables originally accompanying it, those interested further may have access to these tables by applying to Mr. T. K. Chamberlain, Director, U. S. Biological Station, Fairport, Iowa.

valuable shells for button making. Increases among the non-commercial shells were evident in the squaw foot and one of the paper shells (*Proptera laevissima*). From the fact that the clammers discard many of the non-commercial species upon catching, it might be thought that these species would be favored to the extent that they would become dominating species in an extensively clammed area. As a matter of fact decided decreases in their absolute and relative abundance were noted over 1920. According to the calculated data of the table they made up less of the clam bed in 1925 than they did in 1920. Further study may show the extent to which the thin, non-commercial shells through complicated relation-

ships of one kind or another are active agents for the welfare of their thicker shelled brethren, beyond merely representing an adaptation enabling them to survive the changing conditions of the river bottom.

In the relative abundance of species represented, the area is distinctly a "pocketbook" area, the pink heel splitters, blue points and pigtoes being next in abundance; in general the thinner type of species seems most highly favored. The writer was impressed by the almost uniform absence of juveniles in this area in 1925, their place in the river bottom society being taken perhaps by the extremely common Sphaeridae which were brought into the boat by the hundreds on the windlass line. The principal species represented was *Sphaerium stamineum* Conrad. Many dead and dying shells were observed along the banks in this area.

Commencing about a mile above Red Wing, water weeds were rather common in this area and included species of *Philotria*, (*Elodea*), *Potamogeton crispus* and *americanus*, *Zannichelia palustris*, *Ruppia occidentalis*, *Ceratophyllum demersum*, and *Vallisneria spiralis*. Leeches collected crawling about on the mussel shells were pronounced by Professor J. Percy Moore of the Zoological Laboratory, University of Pennsylvania, to be *Glossosiphonia complanata*, *Helobdella stagnalis*, and *Erpobdella stagnalis*. Aquatic insects and crustacea similarly collected were determined by Professor J. G. Needham of Cornell University to be the larvae of the damselflies, *Ischnura verticalis*, *Enallagma* sp. and the orchestid crustacean, *Hyalella Knickerbockeri* Bate.

(To be continued.)

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INTERNATIONAL CONGRESS OF PLANT SCIENCES

(Fourth International Botanical Congress)

Investigators and teachers in the plant sciences, representing all aspects of botany, plant chemistry, plant pathology, and bacteriology, agronomy, horticulture, and forestry are invited to attend the International Congress of Plant Sciences to be held at Ithaca, August 16-23, 1926. This invitation is extended to all countries of the world.

This Congress is scheduled to follow the usual academic sessions in the United States. It is believed to offer the first opportunity ever arranged in the United States for a general conference of all those professionally engaged in plant work. It possesses the additional compelling interest accruing from unrestricted international representation.

In order that a part of the program may be representative of outstanding leadership, the Congress will be divided into about one dozen sections, each section with an invitation program occupying about four morning sessions or a little more than one-fourth of the available time. These formal programs will be supplemented by another feature that promises also to be of exceptional interest. Ample time will be set apart for round table or informal discussions, which in some cases may be scheduled in advance, and in others may be arranged both as to topics and participation after the Congress actually convenes. This is intended to provide for the widest participation in sectional activities. Supplementary opportunities for individual contact and participation are made possible through the non-commercial exhibits and through the provision for excursions and inspection tours of various types suited to the diverse needs of the different sections.

Although the Congress is not to provide an occasion for legislation on regulatory matters of international significance (such as nomenclatorial rules) the organization committee has expressly provided that "adequate opportunity shall be accorded all sections for the discussion of regulatory recommendations of international significance," in order that a bet-

ter understanding may be reached for definite action at a subsequent international congress.

The sections thus far authorized and the secretaries representing these groups are as follows:

- | | |
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| Agronomy—C. H. Myers, Cornell University, Ithaca, N. Y. | Physiology—O. F. Curtis, Cornell University, Ithaca, N. Y. |
| Bacteriology—J. M. Sherman, Cornell University, Ithaca, N. Y. | Pathology—Donald Reddick, Cornell University, Ithaca, N. Y. |
| Cytology—L. W. Sharp, Cornell University, Ithaca, N. Y. | Pharmacognomy and Pharmaceutical Botany—H. W. Youngken, Massachusetts Col. of Pharmacy, Boston. |
| Morphology, Histology and Paleobotany—D. S. Johnson, Johns Hopkins University, Baltimore, Md. | Texonomy—K. M. Wiegand, Cornell University, Ithaca, N. Y. |
| Forestry—R. S. Hosmer, Cornell University, Ithaca, N. Y. | Mycology—H. M. Fitzpatrick, Cornell University, Ithaca, N. Y. |
| Horticulture—A. J. Heinicke, Cornell University, Ithaca, N. Y. | Ecology—H. L. Shantz, Bureau of Plant Industry, Washington, D. C. |
| Genetics—C. E. Allen, University of Wisconsin, Madison, Wis. | |

Communications regarding the Congress should be addressed as indicated below:

1. Concerning round tables and other strictly sectional matters—to the appropriate sectional secretary.
2. Concerning exhibits and general program matters—L. W. Sharp, Cornell University, Ithaca, N. Y.
3. Concerning excursions, collecting trips, inspection tours, local arrangements, transportation, etc.—H. H. Whetzel, Cornell University, Ithaca, N. Y.
4. Concerning the Congress in general—B. M. Duggar, Missouri Botanical Garden, St. Louis, Mo.

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